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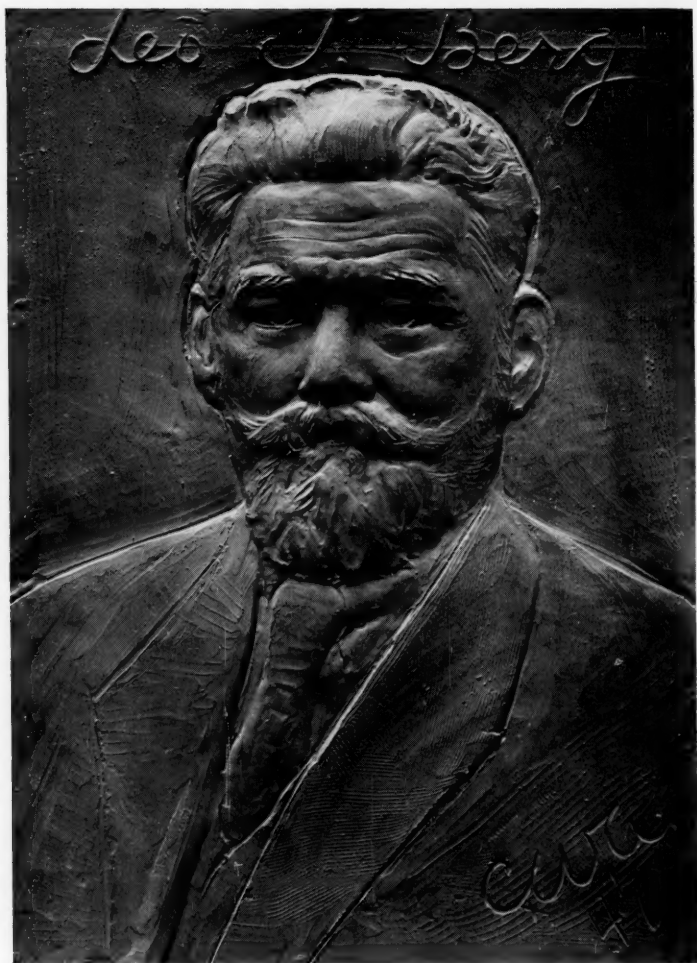
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zoology,
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Leo S. Berg, from a plaque by Carleton W. Angel in the Hall of Fishes, Museum of Zoology, University of Michigan.

Leo Semenovich Berg, 1876-1950

LEO Semenovich Berg, distinguished Russian scientist and since 1937 an Honorary Foreign Member of the American Society of Ichthyologists and Herpetologists, died on December 24th, 1950, at the age of 74. Known to American ichthyologists primarily for his extensive series of works on the freshwater fishes of the USSR and his monumental "Classification of fishes," Berg was equally prominent as a geographer. His 600 published works included important contributions dealing with climatology, paleogeography, the origin of loess, limnology, physical geography and geomorphology, geology, soil science, ethnography, the history of geographic discoveries and explorations, geobotany, and zoogeography. However, it was in ichthyology that he began his scientific career and it is in this field that he made his first and perhaps his most notable contributions.

Berg was born in Bessarabia, in the small town of Bendery, in 1876. In 1894 he enrolled at the University of Moscow, where the noted geographer, anthropologist, and ethnographer D. N. Anyuchin was one of his teachers and undoubtedly influenced him in his broad range of interests. In 1899 he began a series of exhaustive field studies which led to the publication of his classical monograph "The Aral Sea," for which he was awarded the degree of Doctor of Geographical Sciences and the P. P. Semenov-Tianshansky Gold Medal of the Imperial Russian Geographical Society. In a tribute to Berg on the occasion of his seventieth birthday and the completion of fifty years of scientific activity, A. G. Grumm-Grzhimailo said of this work, "for completeness of information and definiteness of conclusion, there has been nothing to equal it in Russian geographical literature." In this first major research, Berg took up the theme which interested him all of his life, the historical changes in climate.

In 1905 Berg became Director of the Department of Fishes, Amphibians, and Reptiles in the Zoological Museum of the Academy of Sciences and retained this post until 1914. This period coincided with World War I; however, even under those strenuous conditions he produced more than twenty books and monographs. Among these was his compendium, "Fresh-water fishes of Russia," a three-volume fourth edition of which has recently been published.

From 1914 to 1918 he held a professorship in the Moscow Agricultural Institute and in 1918 became a professor at the University of Leningrad, lecturing also on physical geography in the Pedagogical Institute and the newly created Geographical Institute. His "Principles of climatology," which appeared in 1926 and which he revised and added to in 1936, is a standard Soviet text. From the "Landscape-geographical zones of the U.S.S.R.," first published in 1930 and enlarged in 1936, he incorporated his teachings in "Priroda S.S.S.R." (1937) which was published in this country in 1950 as

the "Natural regions of the U.S.S.R." While primarily for students of geography, this book is invaluable as a reference work on the USSR for all students of the natural sciences.

In 1939 Berg resumed his work as an ichthyologist at the Zoological Institute of the Academy of Sciences, and in 1940 produced his outstanding study "A classification of fishes, both living and fossil." During the last war, while in Kazakhstan, to which he was evacuated on orders of the Academy of Sciences, he occupied himself with a study of the ichthyology of several lakes. On his return to Leningrad in August, 1944, he resumed his work in the Zoological Institute, where he worked until the time of his death.

A few of his better-known ichthyological works not previously mentioned include "The fishes of Lake Baikal" (1900), "The fishes and fisheries of the delta of the Syr-Darya and the Aral Sea" (1900), "The fishes of Turkestan" (1905), "Fisheries of the basin of the Volga above Saratov" (1906), "Review of the fisheries of the Volga Basin from the River Vetluga to the mouth of the Kama" (1906), "Ichthyologia amurensis" (1909), and the volumes on "Fishes" in the series "Fauna of the U.S.S.R. and adjacent lands" (1914-). He was the author of monographic revisions of nearly all the freshwater fishes of the USSR.

Berg was highly honored both at home and abroad. In 1915 the Geographical Society presented him with its highest award, the Constantinovsky Medal. In 1934, on the completion of forty years of scientific endeavor, the Soviet Government awarded him the title of Meritorious Worker of Science, and in 1945 conferred on him the Order of the Red Banner of Labor. He was a member of the Academy of Sciences of the USSR and during the last ten years of his life was President of the Geographical Society of the USSR. In addition to being an honorary member of the American Society of Ichthyologists and Herpetologists, he was also an honorary member of the Sao Paulo Society of Naturalists, a corresponding member of the Royal Zoological Society of London and a member of the Masaryk Agricultural Academy of Prague and of the American Geographical Society. In 1936 he was awarded the Gold Medal of the Asiatic Society of India for his studies of the zoology of Asia.

A man of encyclopedical knowledge, Berg possessed a brilliant, probing mind, an extraordinary breadth of approach in his studies of natural phenomena, and an astounding capacity for work. At the same time the writer of this notice, on meeting him in 1935, was at once impressed by his warmth and human qualities: his patience, his kindness, and his gentle wisdom. His many students and his co-workers loved and admired him. The world of science suffered a real blow in the death of Leo S. Berg.—LEO SHAPOVALOV, *California Division of Fish and Game, Ferry Building, San Francisco, California.*

Breeding Habits, Development and Early Life History of *Richardsonius balteatus*, a Northwestern Minnow¹

GEORGE F. WEISEL and H. WILLIAM NEWMAN

ONE of the most abundant, widespread, and brightly colored fishes found in the Columbia River drainage is the redbreasted shiner, *Richardsonius balteatus balteatus* (Richardson). Aside from the interest paid to the high variability of its anal ray counts by such early American ichthyologists as Eigenmann (1895: 10-25) and Gilbert and Evermann (1894: 196-197), practically nothing has been recorded concerning this minnow. Few investigations have been made on the life histories of the freshwater fishes of the American Northwest. Since the redbreasted shiner is one of the commoner species and undoubtedly plays an important role as a bait and forage fish, the following observations are considered to be of value.

SPAWNING PLACE AND TIME

Richardsonius has been taken in all the lakes, sloughs and quieter parts of large streams which we have seined in western Montana. On April 2, 1949, the junior author noticed a crowded school of these shiners splashing in a small spring which empties into a slough near Bearmouth, Montana. These fish were evidently spawning. The slough is about $\frac{1}{4}$ of a mile long and 20 to 40 feet wide. Water cress, *Chara*, *Myriophyllum* and *Lemna* grow in profusion. It is fed by a number of warm springs that well up along its west bank and flow over a few feet of riffles before entering the slough, which discharges directly into the Clark Fork of the Columbia River. *Richardsonius* spawns in the riffles leading to the springs and in the welling water of the springs. The water here is from 1 to $3\frac{1}{2}$ inches deep over a bottom of gravel and rocks about the size of the fist. In the particular spring hole where observations were made, there is no plant growth. The temperature of the water in both the spring and slough remained constantly 17° to 18° C. throughout the period of spawning and early development.

No breeding activities were noticed in parts of the slough other than the springs and their outlets. No eggs or prolarvae were found along the mud banks and short stretches of gravel beach or among the aquatic plants and the deeper parts of the slough.

In the spring of 1950 a close watch was kept on this site. None of the minnows taken on March 5 had ripe gonads. Milt was stripped from a single male on March 20, but not from other adults collected. On the afternoon of April 8, shiners were congregated in the springs and riffles along the slough's shore, and eggs were found adhering to rocks. Breeding activities continued until June 17. By this date the shiners had left the breeding grounds and eggs were no longer present.

Richardsonius spawns earlier in this warm spring slough than it does in colder waters. Samples taken from Post Creek, in the Flathead River Valley, Montana, were ripe from May 20 to June 30, and both sexes could be stripped.

¹ Aided by a grant from the Research Committee, Montana State University.

Post Creek is typical of the cold streams in this region, with spring temperatures of 9° to 15° C. *Richardsonius* was still ripe in Flathead Lake, Montana, the last of June. Consequently shiners in these waters must have a later or more extended spawning period than those in the slough.

In Glacier Park, Schultz (1941: 32) found ripe redbase shiners in June and stated that their breeding season was in the spring and early summer. The subspecies *R. b. hydrophlox* (Cope) in Jackson Hole and Green River, Wyoming, is said by Simon (1946: 82) to spawn during late June and early July. However, the localities where the observations by these authors were made are at a considerably higher elevation and have a later spring than the areas considered here.

Since our observations were made only from 12:00 to 5:00 P. M., it is not known whether the shiners spawn at night as well as during the day.

DESCRIPTION OF SPAWNING FISH

Females with ripe gonads ranged from 7.0 to 11.1 cm. in total length and males from 6.0 to 10.4 cm.² Length frequencies of two large collections indicate that the 1-year group includes specimens from 3.0 to 5.9 cm., and the 2-year individuals from 6.0 to 8.5 cm. Not enough of those in the older age-groups were taken to more than guess at their relative sizes. It is evident that *Richardsonius balteatus* does not spawn until it is two or more years old.

The bright coloration of the redbase shiner is intensified in the spring, especially in the males. Ripe males are brassy on all fins, along the sides ventral to the dark lateral band, and in a narrow strip above this dark area. They also have a brassy half-moon below the eye. There is a dark, rosy wash just behind the operculum and at the base of the pectorals, which continues posteriorly in a narrower band to just above the origin of the anal fin. The top of the head, the back, and the lateral band are dark olive to black. The small but numerous tubercles are distributed most profusely over the top of the head and the back, from the nostrils to the origin of the dorsal fin. The pectoral, pelvic and dorsal fins also are frequently tuberculate, and a roughness can be felt on the scales. The gravid females show the same general coloration as the males but it is not so brilliant. Instead of having the brassy hue below the eye and on the sides, they are pale gold. Tubercles are generally lacking; if present, they are only weakly developed. No difficulty was experienced in distinguishing mature males from females by these characters. However, the nuptial colors of the fish from the warm spring slough were more intense than those of specimens from neighboring silty streams.

SPAWNING BEHAVIOR

In the early part of the spawning period, males outnumbered females about ten to one, but the proportion became nearly even toward the last of the season. No activity was observed that properly could be described as fighting or courtship, and no attempt was made by the fish to defend territories or to build any type of a nest.

The shiners were present in schools of thirty to fifty individuals in a pool just below the spring's riffles. They swarmed about in the pool and then, in

² The largest specimen of *R. balteatus* taken by us came from the Clark Fork River at Missoula. It is 13.3 cm. long, with a standard length of 11.3 cm. Eigenmann's (1895) record of a specimen 14.0 cm. from Mission, British Columbia, is the only larger individual that we found recorded in the literature.

small groups of two to fifteen, entered the riffles and the spring hole to spawn. There was no "pairing off." Minnows in the riffles remained quietly upstream, but from time to time they would be seen to arch their backs and dip under the edges of rocks, either in the act of eating or spawning. A water glass was placed over the riffles. In a few minutes the fish swam beneath it with no apparent fright. Through this viewer, groups of two to five minnows were seen to drift a few inches downstream with their tails down and heads elevated, and then to move upstream again in the same position, as if trying to rub their genital papillae on the rocks. Some fish, apparently males, tried to crowd others against rocks. The fish in a single group kept changing position, leaving the group and being replaced by others. After remaining but a few seconds in a spawning huddle, they would leave to remain quietly on the riffles or to return to the school in the pool below. Apparently they take repeated turns in spawning and as many as six or eight crowd together for the act.

Few eggs are deposited at one time. From ten to twenty eggs were found in clusters on rocks and since egg counts for six females averaged 1,852, it probably requires several days for a female to become spent. The number of eggs per fish varied from 829 in a specimen 8.0 cm. total length to 3,602 in one 10.4 cm. long.

The eggs are demersal and adhesive. Since most of them are found on the undersurface of rocks and in narrow crevices, where the fish could not squeeze, they must be swept into that position by the current. Direct observations, as well as stomach analyses, showed that exposed eggs were promptly eaten.

FEEDING HABITS DURING SPAWNING

Richardsonius balteatus feeds during the spawning period. Of eighteen mature males and females taken in the riffles on May 8, three had empty stomachs, one contained molluscs (*Physella* and *Gyraulus*) and algae, four had small water beetles and gammarids, one had an adult dipteran and algae, and nine contained eyed eggs and prolarvae of their own species along with some other partially digested plant and animal residue. A total of 79 fish eggs and larvae were eaten. Sixteen stomach from minnows collected May 19 revealed no cannibalism. Three were empty and the others contained water beetles, adult diptera, dragonfly nymphs, gammarids, algae and sand. There was no particular preference for any of the foods taken. Four adult shiners taken on June 3 from Post Creek had digested insect remains in their digestive tracts. All the fish from the slough were parasitized with small roundworms and spiny-headed worms, but they appeared to be in good condition.

The slough is extremely rich in many types of fish food—molluscs, diptera, water beetles, gammarids, dragonfly nymphs, small forage fish, algae, etc.—but the food taken by *Richardsonius* was not selective. They are principally insectivorous, at least at this time of year and in this locality. The small amount of algae found in their digestive tracts may have been ingested while consuming other food. Notes on the feeding habits of *Richardsonius balteatus* by Carl and Clemens (1948: 85) and of *R. egregius* by Snyder (1917: 57) support the evidence, derived from our few analyses, that fish of the genus are insectivorous.

Redside shiners are definitely cannibalistic and are probably their own worst egg predators. Squawfish (*Ptychocheilus oregonensis*), suckers (*Catostomus commersoni*), and golden shiners (*Notemimetus crassus*) are also known to eat their own eggs.

tomus catostomus) and large brown trout (*Salmo trutta*) were abundant in the same slough, but none of them was seen on the spawning ground of the shiners. Stomachs of five 8- to 10-inch squawfish and two brown trout, which weighed over 2 pounds apiece, contained no eggs, young or adults of *Richardsonius*.

In addition to our record of the redbside shiner consuming its own eggs, other members of the genus have been noticed to follow suckers and feed on their eggs (Snyder, 1917: 56) and to prey on newly released grayling fry (Simpson, 1941, Master's thesis, quoted by Simon, 1946: 82).

DEVELOPMENT AND LARVAL STAGES

For a close study of the development and larval stages of *R. balteatus*, milt was stripped over eggs of two females on April 19. All but a few of the eggs became fertile. They were placed in aerated jars covered with wrapping paper to exclude most of the light. The water temperature was 21° to 23° C. Eggs were removed at intervals and examined under a dissecting microscope. After hatching, the larvae were placed in 10-gallon aquaria. The descriptions and illustrations that follow were made from living material, which is much more satisfactory than preserved specimens.

Eggs.—The freshly fertilized eggs are from 1.9 to 2.2 mm. in diameter, have a pale yellow yolk, and are more adhesive than the unfertilized eggs. They adhere to the sides and bottoms of glassware and tend to clump together.

Early Embryos (26-hour).—The diameter of the eggs, although variable, are the same as freshly fertilized eggs. The embryo develops rapidly and encircles $\frac{3}{4}$ of the yolk's circumference by this time. The eyes are barely discernible and 8 to 10 somites are formed (Fig. 1).

Embryos (60-hour).—The eggs are slightly elliptical. One measured 1.9 mm. in its long axis and 1.4 mm. in the short axis. The embryos are well formed 60 hours after fertilization (Fig. 2). The tail reaches to the back of the head. Eye lenses and ear vesicles, as well as many somites, are present. The heart is tubular and beats with strong regularity. In this stage the embryos are all actively turning within their enveloping membranes.

Late Embryos (78-hour).—This is the period of development just prior to hatching (Fig. 3). Only ten of about 300 eggs hatched at approximately 74 hours. The embryo is larger than that of the previous stage and the yolk sac is considerably smaller. There is no pigment in the eye or elsewhere on the embryo. The size of the egg remains constant.

Hatching.—The embryos generally break from their restraining membranes instantaneously. A few take a minute or so to become entirely free, and from these it can be noticed that the tail comes out first, leaving the head and yolk sac last to come out of the enveloping vitelline membrane. Hatching occurs between 74 and 168 hours after fertilization, which is a rather prolonged hatching period. (This was observed in spawn taken from a single female, fertilized by one male, and kept in one container, so that the eggs were subjected to similar conditions.) It takes place during the night as well as in the day. Agitation of the jar containing the eggs brings on a flurry of hatching.

All of the embryos are in the same state of development at any one time. Those which hatch early are not so well developed as those which break free of the egg membrane later. The yolk sac of the late hatching fish is more

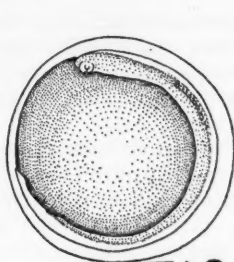


FIG. 1

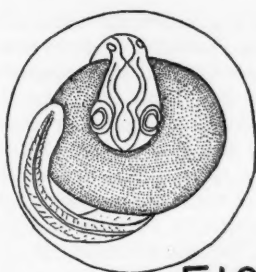


FIG. 2

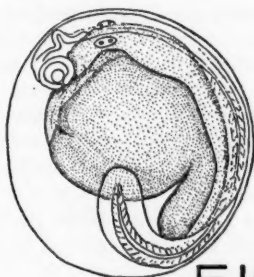


FIG. 3

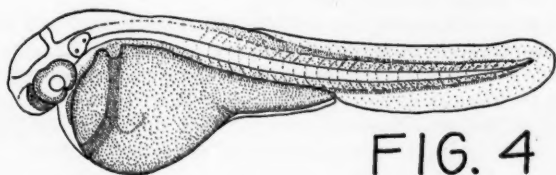


FIG. 4

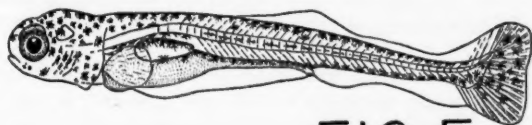


FIG. 5

Figs. 1-5. Embryos and larvae of *Richardsonius balteatus*.

All figures drawn from living material. Fig. 1. Embryo 26 hours after fertilization. Fig. 2. Embryo 60 hours after fertilization. Fig. 3. Embryo just prior to hatching, 78 hours after fertilization. Fig. 4. Newly hatched prolarva, 5.3 mm. in total length. Fig. 5. Early postlarva 10 days after hatching, 8.7 mm. in total length.

absorbed and, unlike the early hatchers, the eyes are pigmented. Since these eggs were reared at temperatures higher than those which prevail under natural conditions, the development was undoubtedly faster than normal. In nature it probably takes from 5 to 10 days for the eggs to hatch, rather than the 3 to 7 days noted in these experiments.

Early Prolarvae (3.9 to 5.5 mm.).—Newly hatched prolarvae have a slightly pigmented eye, but no chromatophores on the body. There is a continuous dorsal and ventral fin fold. The pelvic fins are lacking and no rays are developed in the caudal, dorsal or anal fins (Fig. 4). The yolk sac measures 1.4 mm. in length, the eye 0.4 mm. in diameter, and the postanal tail 1.9 mm. long in prolarvae 5.5 mm. total length. Although varying in size, the prolarvae are in about the identical state of development.

In this stage the larvae remain quietly on the bottom of their aquaria unless disturbed. When startled, they dart erratically for short distances and then settle to the bottom. They avoid light, preferring to remain under rocks and vegetation. In the field, the early prolarvae are found resting on the rocky bottom where spawning has occurred. Their transparency and habit of remaining sheltered under rocks undoubtedly protects them from most predators.

Prolarvae (6.0 to 8.0 mm.).—Four days after hatching most of the young fish measure 7.0 mm. in total length. The pectorals are well developed, but the continuous dorsal and ventral fin folds persist. Rays are apparent only in the pectorals. The eyes are darkly pigmented and large melanophores have developed on the top of the head, along the margins of the fin folds, and are especially abundant around the air bladder and dorsal surface of the digestive tract. The yolk sac is largely absorbed. The relatively small air bladder is not constricted in the middle as it is in the adult.

These prolarvae swim rapidly but jerkily for short distances, 2 to 8 inches, with short pauses between movements. When they cease swimming, they sink to the bottom head foremost. They tend to remain motionless on the bottom or to adhere to the algae along the sides of the aquaria. Due to their small size and transparency, they are difficult to see unless they are in motion. They do not feed at this time and they show no particular avoidance of light.

Late Prolarvae (8.0 to 8.5 mm.).—Eight days after hatching the yolk is practically absorbed. The original transparency is lost because of a general orange tinge about the head, green color along the back, and the addition of more melanophores. The extreme tip of the caudal vertebrae is barely upturned and caudal fin rays are just evident. The gill arches can be seen through the operculum.

Late prolarvae remain in the open water of the aquarium and swim less jerkily. However, constant swimming motions are necessary or they slowly sink to the bottom. There is no attempt to hide among the rocks and plants.

Early Postlarvae (8.7 to 9.0 mm.).—In ten days there is very little yolk left (Fig. 5). Except for the more numerous melanophores and further development of the caudal fin rays, this stage is very similar to the previous one. The tiny fish feed along the sides of the aquarium and void feces, and are now sufficiently buoyant so that they do not sink when swimming movements cease. This results from absorption of the yolk and enlargement of the air bladder.

Postlarvae (10.4 to 10.6 mm.).—Seventeen days after hatching the yolk is completely absorbed and the air bladder is larger, but still undivided. Al-

though dorsal and ventral fin folds are continuous, there are 6 rays in the dorsal fin. The anal fin has no rays. The caudal rays and the hypural plates are well developed. The eyes are 0.8 mm. in diameter, the head 2.2 mm. long, the air bladder 1.1 mm., and the postanal tail 3.8 mm.

Postlarvae (11.0 to 11.8 mm.).—The air bladder of 24-day old fish is constricted into an anterior and a posterior chamber (Fig. 6). The dorsal and

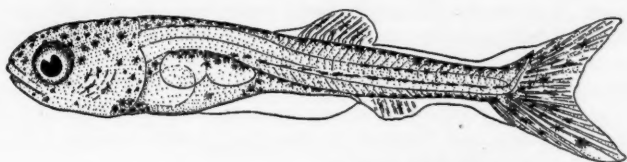


FIG. 6



FIG. 7

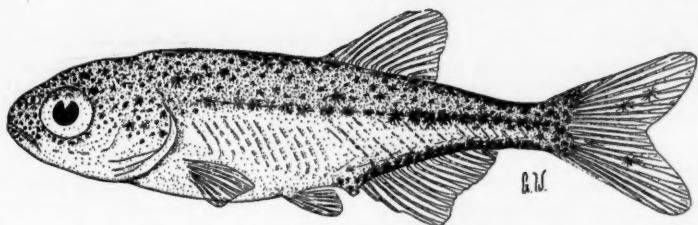


FIG. 8

Figs. 6-8. Postlarvae and juveniles of *Richardsonius balteatus*.

Figures 6 and 7 drawn from living material. Fig. 6. Postlarva 24 days after hatching, 11.5 mm. long. Fig. 7. Late postlarva, 13.0 mm., 46 days after hatching. Fig. 8. Juvenile 3 months after hatching, 21.5 mm. long.

ventral fin folds are present but reduced. There are 9 rays in the dorsal fin and 7 to 10 forming in the anal. The pelvics still are not evident. The chromatophores in this stage are distributed as in the preceding one.

Late Postlarvae (12.8 to 13.4 mm.).—Forty-six days after hatching, postlarvae have 10 dorsal rays and 11 to 15 anal rays. The caudal and pectoral fins also have fully developed rays; the pelvic fins and rays are just commencing

to form (Fig. 7). All but a tip of the dorsal fin fold near the caudal is lost, but a larger portion of the ventral fin fold, from the anus to below the middle of the gut, remains. Melanophores are more numerous and are particularly abundant along the base of the anal fin. One of the critical periods in the life of reidside shiners reared in aquaria is between the third and fourth week after hatching. During this time many become emaciated and swim weakly.

Juveniles (17.1 to 21.5 mm.).—The specific characters of *R. balteatus* that are three months old may be easily recognized (Fig. 8). The lower part of the head, belly and sides are silvery. A narrow band of melanophores extends along the middle of the back. There is a wider dark band in the posterior half of the lateral line and another above the base of the anal fin. Such characteristics as the long, black-bordered anal base, the lack of a definite black spot at the caudal base, and the relatively deep body readily separate it from other minnows of the Clark Fork drainage.

SUMMARY

The reidside shiner, *Richardsonius balteatus balteatus* (Richardson), is one of the commonest fishes found in the upper Columbia River. In western Montana they spawn in their second year, from the first of April to July. The spawning grounds are in the shallow water of rocky riffles or in welling springs. They exhibit no obvious courtship behavior and spawn in groups. No nest is constructed; the demersal eggs are broadcast over the bottom and adhere to rocks or detritus. Although the minnow is essentially insectivorous, it will eat its own eggs.

At laboratory temperatures of 21° to 23° C., the eggs hatch in 3 to 7 days. The young remain as prolarvae for 8 days. During this period they are quietly hidden in the rocks of the spawning area. The postlarval stage lasts until they are about 46 days old. They take food when 10 days old. Although the yolk sac is absorbed in these young, the pelvic fins are not developed and a portion of the dorsal and ventral fin folds persists. The postlarvae are active swimmers and apparently make no effort to remain hidden. Juveniles are essentially similar to the adults.

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UNIVERSITY OF MONTANA, MISSOULA, MONTANA.

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Chilorhinus brocki, a New Echelid Eel from Hawaii, with Notes on the Classification of the Order Anguillida¹

WILLIAM A. GOSLINE

IN A recent paper (Gosline, 1950), I have shown that eels of two very different groups had hitherto been included in the Echelidae. One of these, exemplified by *Muraenichthys*, belongs with the Ophichthidae (improperly spelled Ophichthyidae, see Gosline, in press). The other group, represented by *Kaupichthys*, appears to be most closely related to the Heterenchelidae. In the belief that *Echelus*, which I have not seen, will prove to be of the *Kaupichthys* type, I have assigned the family name Echelidae to the *Kaupichthys* group of eels and have removed the family from its old position next to the Ophichthidae. In the present paper, a new species related to *Kaupichthys* is described, its osteology and relationships are dealt with, and observations are made on the classification of the family and order to which it belongs.

GENUS *Chilorhinus* LÜTKEN

Chilorhinus Lütken, 1851: 272 (Original Danish description not seen; I cite throughout from Lütken's German translation of his paper, apparently published the same year.)

Small, short-bodied eels with posterior nostril opening on inside of upper lip. Dorsal and anal well developed and confluent around tip of tail, the dorsal beginning shortly behind the gill openings. Vomerine teeth in a longitudinal row on either side, the two rows aligned in the form of a horseshoe but with the teeth absent from the forward, closed end of the horseshoe (Fig. 1B). Lower lip forming a fold along each side of lower jaw (Fig. 1A); this fold is given as a characteristic of *Chilorhinus suensoni*² by Schultz and Woods (1949: 170) but is not mentioned in Lütken's original description of the species. Pectorals minute or absent.

This genus appears to be most closely related to *Kaupichthys* Schultz (1943: 50), from which it differs externally in the folds of the lower lip and in the rudimentary or absent pectorals. (According to Lütken and to Evermann and Marsh (1900: 72), the pectorals of *C. suensoni* are minute, but Schultz and Woods (1949: 170) stated that this species has no pectorals.)

Chilorhinus has hitherto been regarded as monotypic and recorded only from the West Indies.

Chilorhinus brocki, sp. nov.

Holotype: 85 mm. in total length, taken at a shallow-water poison station in Kewalo Basin, Honolulu, Territory of Hawaii, October 29, 1948, by V. E. Brock and J. P. Welsh.

¹ Contribution No. 7, Hawaii Marine Laboratory.

² The International Commission on Zoological Nomenclature has ruled that a modern patronymic based upon the surname of a man is to be formed by adding a single i to the exact name of the individual honored. Opinion 8 has been cancelled. (1950, Bull. Zool. Nomen., 4: 68, 200-09).

Paratypes: 11 specimens, 58-76 mm. long, from the same collection as the holotype.

The holotype (USNM No. 112312) and two paratypes (USNM No. 112313) have been deposited in the U. S. National Museum. Two paratypes (SU No. 16113) have been sent to Stanford University, and two (BM No. 4151) are in the Bernice P. Bishop Museum. The remaining five paratypes (UH No. 49) have been retained in the University of Hawaii fish collection; one of these, a specimen 65 mm. long, has been dissected.

This is a small eel with a broad, depressed snout, a swollen gill region, and the body compressed, particularly posteriorly. Depth of body in the expanded gill region contained 16 times, over the anus 19 times, in the total length of the holotype.

Head, measured from tip of snout to gill opening, about 5 in total length. Width of head at eyes considerably greater than snout length. Anterior nostril in a short tube at tip of snout; posterior nostril an elongate cavity, about half an eye diameter in length, on inside of upper lip below anterior

TABLE I

MEASUREMENTS OF THE HOLOTYPE AND TEN PARATYPES OF *Chilorhinus brocki*

All measurements, except total length, are expressed in thousandths of the total length. Since the paratypes show no indications of allometric growth within the size range represented, their data are combined. Figures for paratypes outside parentheses are averages, within parentheses are ranges.

Measurement	Holotype	Paratypes
Total length in mm.....	85	66 (58-76)
Snout.....	34	39 (35-43)
Eye.....	20	22 (20-24)
Tip of snout to rictus.....	45	49 (47-54)
Width of head at eye.....	57	50 (46-52)
Tip of snout to gill opening.....	185	198 (183-214)
Tip of snout to dorsal origin.....	258	248 (236-257)
Tip of snout to anus.....	476	462 (438-493)

rim of eye. Snout with numerous small papillae in largest specimen, its tip with a very slight median groove. Eye well developed and well demarcated from skin of head, except above. Cleft of mouth horizontal, wide, but not very deep; rictus about below the posterior border of eye. Lower jaw slightly shorter than upper. Each side of lower jaw with a rather broad downward flap extending from the rictus nearly to the front of the jaw. Teeth conical, separated into three groups in the upper jaw (Fig. 1B). There is a patch of about 25 teeth in front in the premaxillary area. This is followed posteriorly by two almost concentric, more or less longitudinal rows of teeth on each side of the mouth, the inner rows on the vomerine area and composed of 13 teeth on either side, the outer on the maxillaries and made up of about 20 smaller teeth on each side. The maxillary rows extend somewhat farther posteriorly than do the vomerine teeth. Lower jaw short and broad, its teeth in a single row posteriorly, but in irregular rows forward. There is no tongue, but the floor of the mouth appears to be depressible.

Gill cavities saccate; gill opening a small lateral hole with puckered rim. Longitudinal grooves running along the throat externally in the gill region, the whole area greatly resembling the same region of *Muraenichthys*.

Lateral line of the body apparently without true pores, but with a series of pit organs especially well developed posteriorly. Sensory pores of the head region reduced in number (Fig. 1A); there is no transverse series across the nape behind the skull, no supraorbital series, and no postorbital pores. There are, however, several lines of pit organs where these series normally occur.

Pectorals absent. Dorsal origin one third or one fourth of a head length behind the gill openings. Dorsal and anal highest posteriorly and around tip of tail. Anus slightly nearer to tip of snout than to end of tail, somewhat more than one head length behind the gill openings.

Top of head gray-black; sides of head and body brown, the dark coloration made up of numerous small spots. Belly light, with a few scattered spots. Dorsal and anal fins gray-black except for a narrow irregular light border along posterior part of dorsal and along all of anal.

The new species seems to differ from Lütken's (1851: 272) brief description of *Chilorhinus suensoni* chiefly in lacking pectorals. The more detailed account of *C. suensoni* by Evermann and Marsh (1900: 72) indicates that that species and *C. brocki* are certainly very similar in general features. Those authors mentioned the pectorals and also a large tooth on the vomer behind the "nasals"; neither are present in *C. brocki*.

The species is named for Mr. Vernon E. Brock, of the Territorial Division of Fish and Game.

OSTEOLOGY

As I have already presented an account of the osteology of the related *Kaupichthys* (Gosline, 1950), I shall restrict the present description of the skeletal features of *Chilorhinus brocki* (Fig. 1).

The lateral-line canals of the head and body are weakly ossified. The number of pores leading to the exterior from these canals is reduced in essentially the same regions as in *Kaupichthys*, but the reductions are slightly greater.

The suspensorium of *Chilorhinus* is somewhat forwardly inclined. The palatopterygoid (pp) is laminar, wedged in between the hyomandibular (hm) and the quadrate (qu) posteriorly, and attached to the vomer (vo) by ligament anteriorly. The maxillary (mx) articulates with the premaxillary-ethmovomer (pv) rather near the end of the rostrum. The opercle (op) differs from that of *Kaupichthys* in being rounded above. The preopercle (po) is a straight rod, closely appressed to the posterior edge of the hyomandibular. The body of the subopercle (sr) is a flat lamina; from its postero-ventral angle issues a branchiostegal-like process which encircles much of the opercle.

In the skull, the premaxillary-ethmovomer is a single fused bone. The orbitosphenoid (os) appears at the surface of the skull only forward of the sutural union between the frontal (fr) and the parasphenoid (ps). The swollen otic bulla (ob) is made up of the basioccipital (bo) and prootic (pr) ventrally. On the dorsal surface of the skull, the ethmoid (et) forms a

triangular projection extending over and between the frontals. The frontals are large and completely divided by a suture. The supraoccipital (so) is

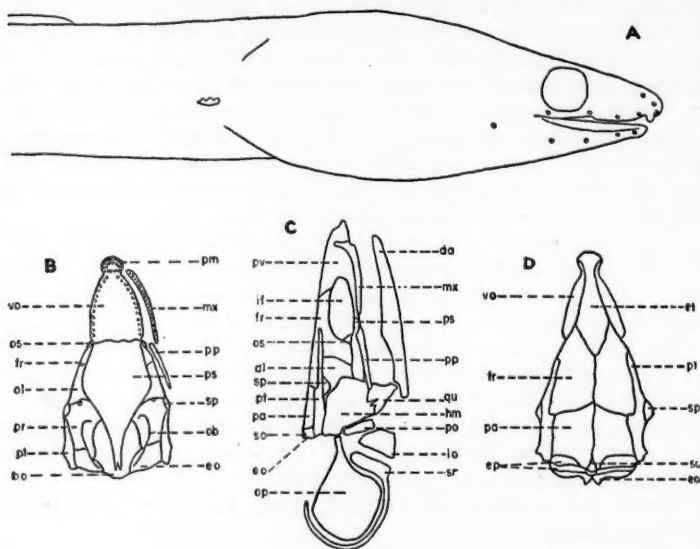


Fig. 1. *Chilorhinus brocki*. A. Outline drawing of head showing position of sensory-canals. B. Ventral view of skull. C. Lateral view of skull with maxillaries, suspensorium, lower jaw, and opercular apparatus. D. Dorsal view of skull.

al alisphenoid
bo basioccipital
da dentary (the articular-angular is not delimited)
eo exoccipital
ep epiotic
et ethmoid region of premaxillary-ethmovomer
fr frontal
hm hyomandibular
if interorbital opening
io interopercle
mx maxillary
ob otic bulla
op opercle
os orbitosphenoid

pa parietal
pm premaxillary area of premaxillary-ethmovomer
po preopercle
pp palatopterygoid
pr prootic
ps parasphenoid
pt pterotic
pv premaxillary-ethmovomer
qu quadrate
so supraoccipital
sp sphenotic
sr subopercle
vo vomerine area of premaxillary-ethmovomer

minute and flat. The first vertebra is not fused to the skull.

In the hyoid arch, the glossohyal is well developed; the urohyal is a small horseshoe-shaped ossification; and the ceratohyal and epihyal are

relatively short and stout as compared to those of *Kaupichthys*. There are 21 branchiostegal rays on each side; the anterior 7 of these are rather widely spaced, but the posterior 14 are crowded; the rays of the two sides do not overlap on the midventral line.

The gill arches are rather well ossified, with wide openings between them. Both upper and lower pharyngeals are in the form of elongated pears with the narrow end forward; the upper pharyngeals are slightly broader than the lower ones. Considering the size of the fish, the conical pharyngeal teeth are large; there are 14 such teeth on each lower and 15 on each upper pharyngeal.

The pectoral girdle is represented by a well-developed cleithrum and somewhat farther forward by a hair-like supracleithrum. Scapula, coracoid, and actinosts are absent.

The vertebrae number 107 in the specimen examined; the first apparently consists of a short centrum only. There are well-developed neural spines and transverse processes from the third vertebra on. In the anterior caudal region, the neural and haemal spines become extremely long. There are no articulated ribs, but fine unarticulated epineurals and epipleurals are present.

RELATIONSHIPS OF *Chilorhinus* AND DEFINITION OF THE ECHELIDAE

Compared with *Muraenichthys cookei*, an ophichthid which it superficially resembles, *Chilorhinus* differs in having paired frontals united by suture, a broad flat skull, small orbitosphenoids, a broad vomer devoid of teeth in the center, branchiostegal rays that do not overlap on the midventral line, vertebrae with well-developed neural and haemal spines, and a reduction in the number of pores in the lateral-line system. The nature of this list of characters indicates that the external similarity between *Chilorhinus* and *Muraenichthys* is the result of parallel evolution and not of close genetic relationship.

Osteologically as well as superficially, there are also differences between *Chilorhinus* and *Kaupichthys*, but these are of a more trivial nature so far as eel classification is concerned. The skull of *Chilorhinus* is broader and flatter than that of *Kaupichthys*. This change in skull shape is naturally reflected in the shape of the individual bones. Thus the vomerine plate of *Kaupichthys* is far narrower than that of *Chilorhinus*, and its tooth rows much less widely separated. The interorbital opening is small and vertically elongate in *Kaupichthys*, whereas in *Chilorhinus* it is large and longer than high. The orbitosphenoid is an elongate bone exposed at the surface in *Kaupichthys*; in *Chilorhinus* it seems to have been largely covered over by the parasphenoid and frontals. However, exactly these same differences, except for the widely-spaced vomerine tooth rows, are duplicated in the high-headed and long-headed members of the Ophichthidae (Gosline, in press).

The pectoral girdle is greatly reduced in *Chilorhinus*, but in *Kaupichthys* it is relatively well-developed with scapula, coracoid, and four actinosts pres-

ent. Again, the pectoral development is very variable within certain other eel families.

The vertebrae of the two genera also differ. The centrum of the first vertebra bears a well-developed neural arch in *Kaupichthys*, which is apparently lacking in *Chilorhinus*. However, besides being particularly subject to damage by errors of dissection, the nature of the first vertebra is very confusing in eels. For example, the neural arch of the first vertebra of *Chilorhinus* may have been incorporated into the skull, as indicated by Trewavas (1932, Pl. 1) for *Stilbiscus*; on the other hand, I feel that the element labelled first neural arch on Trewavas' plate may equally well be the exoccipital, and that the neural arch of the first vertebra of *Stilbiscus* may be lacking. A further difference in vertebrae between the genera under discussion is that, from the third vertebra on, there are well-developed neural spines in *Chilorhinus*, whereas in *Kaupichthys* the first few vertebrae bear several spinelets but no single enlarged spine.

On the basis of the osteology of *Kaupichthys* and *Chilorhinus*, a diagnosis of the family to which they belong may be developed as follows. (This family is here called the Echelidae, though to write a diagnosis of the Echelidae without having seen *Echelus* is, admittedly, to reckon without the host.)

Naked eels with well-developed vertical fins confluent around the tip of the tail. Posterior nostril labial, penetrating either the inside or the outside of the upper lip. Frontals united by a suture for their entire length. Vomer a broad plate ankylosed to the premaxillaries and ethmoid, bearing either a broad band (in *Echelus*) or two well-separated rows of teeth. Otic bulla enlarged, its expanded ventral portion composed of the basioccipital and prootic. Suspensorium nearly vertically suspended. Palatopterygoid laminar. Branchiostegal rays in moderate number (15 in *Kaupichthys*, 21 in *Chilorhinus*), those of the two sides not overlapping below. Pores of the lateral-line system reduced in number; those on the body largely absent or replaced by pit organs, those of the transverse canal across the nape, and of the postorbital and supraorbital canals, entirely lacking. Pectorals present or absent. Vertebrae few for eels (97 in *Kaupichthys*, 107 in *Chilorhinus*). Neural and haemal spines well developed. Epineurals and epipleurals present, but articulated ribs absent. Anus forward of the middle of the body.

NOTES ON THE CLASSIFICATION OF EELS

In spite of the major contributions by Gill (1891), Regan (1912), and Trewavas (1932), the higher classification of the eels (Order Anguillida) remains rather rudimentary. This is in part because many of the families are based on rare forms, the osteology of which is insufficiently known. Though no classification of the group can be satisfactorily established until the morphology of many more eels is investigated, certain notes on the subject seem worth presenting at this time.

Primary groupings of the eels have been made in three ways. Cope's (1871: 456) separation of the Muraenidae from all other eels because of

their pharyngeal jaws and associated gill-arch characters has long been abandoned. The gill-arch structure of the Muraenidae, though highly specialized, is easily derivable from the gill-arch system of other eels.

Gill (in Goode and Bean, 1895: 161) placed *Derichthys* in a separate order from all other eels. This order he characterized as having well-developed "intermaxillaries" (premaxillaries) united to the "supramaxillaries" by suture; according to Gill the intermaxillaries of other eels are lacking (actually they are fused with the ethmo-vomer). However, Trewavas (1932) demonstrated that *Derichthys* is essentially similar to other eels in the structure of the upper jaw. Beebe (1935: 13), working again on *Derichthys*, stated that on the dorsal surface the premaxillaries and ethmoid are "firmly attached by suture, not ankylosed as in Trewavas' specimen." This I believe to be a misstatement of Trewavas' position, which in turn has led to further error. The figures by Trewavas (1932: 641, Text Figs. 2A and 2B) show a suture between the premaxillaries and the ethmovomer dorsally but *not* on the ventral surface; Beebe's figures show exactly the same thing. It seems highly probable that in *Derichthys* the premaxillaries are ankylosed to the vomerine region below but not to the ethmoid above. (Examination of the dorsal surface of the premaxillaries may have led Gill into the opinion that they formed a separate unit in *Derichthys*.) Berg (1940: 450) has compounded Beebe's error by interpreting Beebe's statement at face value and by redrawing his figure of the ventral surface of the rostrum of *Derichthys* with a suture, not present in Beebe's original figure, added between the premaxillary and vomerine regions.

Regardless of the nature of the junction of the premaxillary and ethmovomer in *Derichthys*, this same junction is variously represented in other eels. The dentigerous sections of the vomer and premaxillaries are often separated by a toothless interspace. In the Heterenchelidae, the two bones are said to be united by suture (Regan, 1912: 382 and Fig. 1). In *Anguilla* the two bones originate as separate ossifications (Trewavas, 1932: 640 and Text Fig. 1) and become ankylosed in the adult. In *Kaupichthys* the premaxillaries are separated from the remainder of the premaxillary-ethmovomerine plate dorsally by a cartilaginous area. Consequently the separation of the premaxillaries from the ethmovomer seems of dubious value as a primary basis for dividing the eels.

According to Regan's (1912) classification, modern eels are divided into those with the frontals ankylosed and those with the frontals united by suture. In the eel skulls I have examined there is no reason to doubt the value of this character; yet, two sources of information tend to discredit it. According to Trewavas (1932), two eel families have the frontals fused anteriorly but not posteriorly. Secondly, there is complete disagreement between Trewavas (1932: 641) and Beebe (1935: 9) as to whether the frontals of *Derichthys* are united by suture (Trewavas) or ankylosed (Beebe). Either (a) one of these authors is incorrect; (b) the genus is variable in this character, and the character itself is of limited usefulness for classification of eels; or (c) these two authors have been investigating species belonging to entirely different families. If the second contingency is

correct, then we must review the basis of our present eel classification, but I should not care to suggest this until contingencies (a) and (c) have been checked.

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DEPARTMENT OF ZOOLOGY, UNIVERSITY OF HAWAII, HONOLULU, T.H.

A Comparative Study of the Reproductive Systems of Several Teleost Fishes

DALE C. BRAUNGART

THE present study is a continuation of a problem begun by Dr. J. B. Parker who is no longer able to pursue it. In his studies on the reproductive system of the yellow perch, Parker (1942) observed that there is no urinogenital sinus. Again, in 1943, he noted the absence of a urinogenital sinus in the brown trout. This led him to suspect that probably no teleost fish has a urinogenital sinus. Consequently, several teleosts were collected by him, among them *Fundulus heteroclitus*, *Micropterus salmoides*, *Pomoxis nigromaculatus*, and *Morone americana*, with the hope that the investigation could be continued, but due to the ill health of Dr. Parker he turned over the material to me for further investigation. The results are set forth in the following discussion.

A careful study was made of the reproductive systems of these fishes, and some deviation from the original observation was found. It was originally thought that probably the reproductive systems of all teleosts were similar to those of the yellow perch or brown trout. This, however, was found not to be true for *Fundulus heteroclitus*. In the female, as in the yellow perch, there is a single ovary formed apparently by the fusion of a pair. The eggs are liberated into a central cavity running the length of the ovary. A peritoneal membrane is closely adherent to the ovary, enclosing it completely as in most teleosts (Kendall, 1921). At the posterior end this membrane is free and forms a tube that narrows as it proceeds posteriorly to become the oviduct. Therefore, the ova are conveyed to the exterior of the body cavity by a closed canal or tube composed of the same enveloping membrane that encloses the ovary.

The urinary duct is posterior to the oviduct in *F. heteroclitus* as in other teleosts, and the intestine lies anterior to both ducts (Fig. 1). As the urinary duct and oviduct leave the abdominal cavity, they are surrounded by a common envelope which, in the form of a tube, extends far behind the anus along the anterior border of the anal fin. Together the oviduct and urinary duct open into this duct or tube (Fig. 1). This accessory tube, called the genital pouch by Hubbs (1924: 12), may be a urinogenital sinus, but as far as can be determined its morphological significance is not known. This common duct for the urinary and genital products extends posteriorly for a considerable distance beyond the openings of the urinary duct and the oviduct. It appears that the two ducts are contained in what might be called a urinogenital papilla that empties its products into a urinogenital sinus (Fig. 1). The oviduct and the urinary duct are united throughout their lengths. On the ventral side this papilla is closely adherent to the skin, but on the dorsal side it is bounded by a backward extension of the accessory tube for more than half of its length. The external opening of this tube is as far from the termination of the two ducts as their terminus is from the anal opening.

In the male the urinary duct and the genital duct bear the same relationship as they do in the female (Fig. 2). Both the urinary duct and the sperm duct open separately, although, as in the female, both ducts are contained in what might be termed a urinogenital papilla. Again both of these ducts are surrounded by an accessory duct or tube, although the terminus of the urinogenital papilla is approximately at the end of the surrounding duct instead of being located midway along the accessory duct as it is in the female. The two ducts terminate together in this papilla surrounded by the accessory duct. It is possible, however, that the papilla in the male may be extruded beyond the duct, since the papilla is strongly muscular and since it is located just inside the genital opening.

This accessory tube in both the male and female may represent a urinogenital sinus. The question now arises whether it is a true urinogenital sinus, as represented in the dogfish, or a peculiar development in this fish having no relationship to the urinogenital sinus of other fishes. It appears that the answer to this question is dependent on a careful embryological study of the comparative anatomy of fishes. Whether or not it is a true urinogenital sinus can be determined only by further research.

The black crappie (*Pomoxis nigromaculatus*) may be used as an example of the type observed in the other teleosts studied, namely, the white perch and the bass. In these fishes the urinary and genital ducts open to the outside of the body separately—as described for most teleosts by Goodrich (1909). In the female, although the eggs are discharged through a separate duct to the outside of the body, the orifice of this duct is partially closed until the actual time for the discharge of the eggs (Fig. 3). In the male crappie the urinary duct and the sperm duct open to the outside of the body through separate orifices, although both open to the outside on the same papilla (Fig. 4). It can be seen that in the fishes dealt with here separate, independent openings lead from the body to convey the genital products to the outside. In none of the females do the eggs rupture through the body wall as they do in the yellow perch described by Parker (1942).

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DEPARTMENT OF BIOLOGY, THE CATHOLIC UNIVERSITY OF AMERICA, WASHINGTON, D.C.

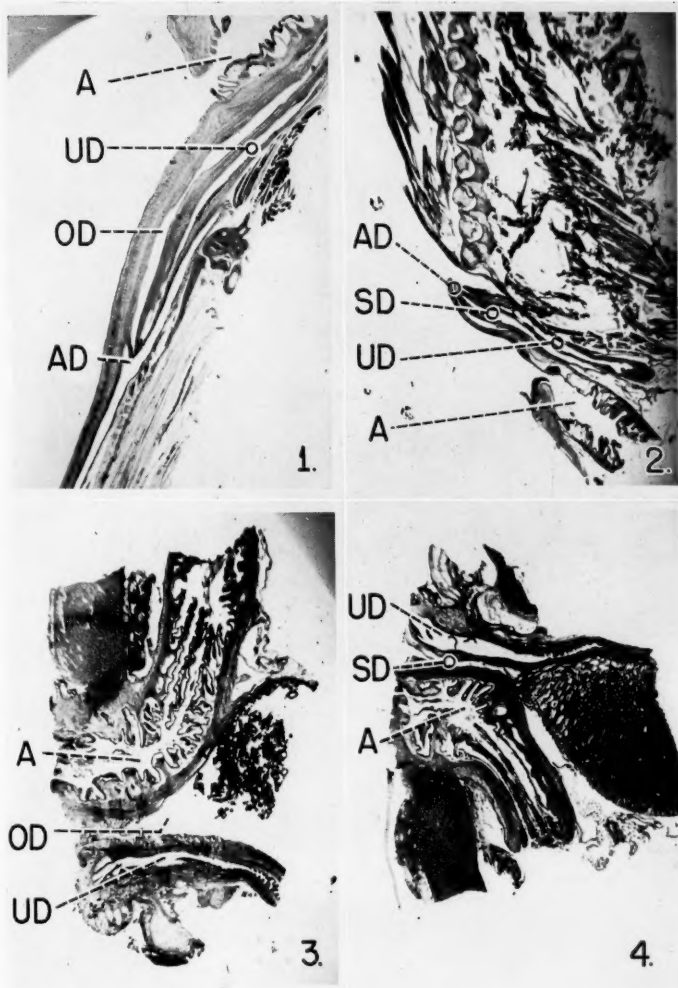


Fig. 1. Female *Fundulus heteroclitus*. Longitudinal, median, vertical section through papilla, showing accessory duct or tube, urinary duct, oviduct, and anus.

Fig. 2. Male *F. heteroclitus*. Same section through papilla showing accessory duct or tube, urinary duct, sperm duct, and anus.

Fig. 3. Female crappie. Same section showing urinary duct, oviduct, and anus.

Fig. 4. Male crappie. Same section showing urinary duct, sperm duct, and anus.
AD—accessory duct or tube; UD—urinary duct; OD—oviduct; SD—sperm duct; A—anus.



Fig. 1. Juvenile *Elattarchus archidum*, representing stage described from Perú as *Odontoscion australis*. Specimen 59 mm. in standard length collected at San Carlos Bay, Gulf of California on February 1, 1950. Photographed by John B. MacFall.

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Odontoscion australis, the Juvenile Stage of
Elattarchus archidium, a Panamaic Sciaenid Fish¹

CARL L. HUBBS AND BOYD W. WALKER

DURING the identification by the junior author of large series of croakers (Sciaenidae) recently collected in the Gulf of California, certain young specimens (Fig. 1) were encountered that correspond very closely with the original description and figure of *Odontoscion australis*, described by Hildebrand (1946: 280-82, fig. 59) from Perú. Except for their boldly striped color pattern, in which respect they resemble the juvenile stage of certain other sciaenids, for example *Cheilotrema saturnum* (Girard) of California, these Gulf specimens also agree well with the descriptions of *Elattarchus archidium* (Jordan and Gilbert). That species was described as *Odontoscion archidium* by Jordan and Gilbert (1882: 316-18) and was referred to *Bairdiella* by Jordan and Eigenmann (1899: 383-86) and to *Corvina* by Boulenger (1899: 4). It has long been placed in a monotypic genus under the name *Elattarchus archidium* (Jordan and Evermann, 1898: 1431-32; Gilbert and Starks, 1904: 125-26; Meek and Hildebrand, 1925: 628-29). In counts and measurements the Gulf specimens agree satisfactorily with both nominal species and in the diagnostic canine dentition they correspond with the detailed description of *E. archidium* by Gilbert and Starks.

Elattarchus archidium is one of the many endemic species and represents one of the several endemic genera in the outstandingly rich sciaenid fauna of the Panamaic region. It has been recorded from San Juan Lagoon, near Guaymas, Gulf of California (Gilbert and Starks, 1904: 126) to Ecuador (Boulenger, 1899: 4).

Several small series of specimens were collected from January 29 to February 1, 1950, in the Gulf of California along the coast of Sonora, México, by the junior author and his assistant Arthur O. Flechsig, with the aid of David Joseph, Kenneth S. Norris and Andreas B. Rechnitzer, students of the authors. Data follow: collection W50-20, Miramar Beach on Bocoichibampo Bay, near Guaymas, Lat. 27° 55' 07" N., Long. 110° 58' 22" W., 1 yearling 54 mm. in standard length; W50-36, sand beach about 1 mile east of San Carlos Bay, near Guaymas, Lat. 57° 56' 50" N., Long. 110° 04' 35" W., 8 yearlings, 53-66 mm. long; W50-43, vicinity of Boca del Río Mayo, Lat. 26° 40' N., Long. 109° 47' W., 2 half-grown 107-109 mm. long; W50-47 and W50-49, San Carlos Bay, Lat 27° 57' 10" N., Long. 111° 05' 35" W., 2 yearlings, 59-63 mm. long.

After comparing our young specimens from the Gulf of California with the references cited above, we concluded that *Odontoscion australis* was probably based on the young of *Elattarchus archidium*. This conclusion was verified by the senior author at the United States National Museum. With the active and friendly cooperation of Leonard P. Schultz, curator of fishes, the types of the two nominal species were examined, along with other critical specimens from Panamá.

¹ Contributions from the Scripps Institution of Oceanography, New Series, No. 505.

The adult stage, of plain coloration and with the lowermost preopercular spine much enlarged and abruptly downcurved posteriorly, is represented in the National Museum by 2 cotypes of *O. archidium* from Panamá—USNM No. 29266, 152 mm. in standard length, and No. 29518, 162 mm. long. Three very similar specimens, No. 50404, 151-159 mm. long, were also collected by Gilbert at Panamá, but were not designated as cotypes.

The juvenile stage (Fig. 1), with bold stripes and with the lowermost preopercular spine still directed more backward than downward and not yet greatly enlarged, is represented in the National Museum by 4 types of *O. australis* seined from Lobos de Tierra Bay, Perú, at Lat. $06^{\circ} 26' S.$, Long. $80^{\circ} 51' W.$, by M. J. Lobell on May 7, 1941. The holotype, USNM No. 128023, measures 66 mm. in standard length; the 3 paratypes, No. 128024, 60, 71 and 73 mm.

The juvenile color pattern of *E. archidium* (Fig. 1) is not very accurately shown in the type figure of *O. australis*. The dorsolateral stripe was drawn with a strong downward curve, so that it wrongly appears to approach the median band, whereas in the specimens these parallel bands remain approximately equidistant. Furthermore, the bands and the caudal spot are shown too weak and the dorsal stripe is not sharply indicated.

The connection between the juvenile (*australis*) and the adult (*archidium*) phases is clearly demonstrated by additional specimens collected near Panamá in 1935 and 1937. One young of 36 mm., USNM No. 144651, collected on Pedro Gonzales Island of the Pearl Islands by Samuel F. Hildebrand on March 1, 1935, shows in simplified form the coloration of the types of *O. australis*. There is no indication along the lateral line of the forwardly directed spur of the median stripe, where the lateral line rises above the stripe, and no trace of the short broken stripe that is also developed in larger young on the lower anterior side. The 3 primary stripes are bold, as is also the large dark spot on the caudal base. Two half-grown, USNM No. 144652, 120 and 127 mm. long, from Panamá Bay, preserved in March, 1937 by Mr. Whaler for S. F. Hildebrand, show fading traces of the lateral stripes and the caudal spot of the young, but have already developed a long, strong, downturned lower preopercular spine. In 2 specimens of intermediate size, 107-109 mm. long, from near Boca del Río Mayo, Sonora, México, the lowermost spine is considerably strengthened but is downcurved only near the tip. Close scrutiny, however, shows that the spine in the half-grown and adult specimens has a subhorizontal base. These observations indicate that the spine is originally oriented at a down-sloping angle of only about 30° and that it becomes strengthened and abruptly bent downward to an angle of 90° or more with the horizontal as the fish transforms from the juvenile to the subadult phase. The study of these series eliminated all remaining doubts concerning the pertinence of *O. australis* to *E. archidium*.

The preopercular spines in the types of *O. australis* negate its reference to *Odontoscion*, even though the spines are still rather small and are largely covered by membrane in well-preserved specimens like the types, and even though the lowermost spine has not yet become greatly enlarged and downcurved. In addition to the few spines, which are similarly characteristic of *Bairdiella*, the preopercular margin in the young *E. archidium* also bears

numerous sharp though soft points, like those of *Odontoscion*. Such points, but no true spines, are borne on the preopercular margin of *O. xanthops*, as represented by 3 adults (USNM Nos. 80762-64) collected at Panamá by Meek and Hildebrand. The relationship between *E. archidium* and *O. xanthops* appears to be much less intimate than is suggested by Hildebrand's comparison (1946: 282).

To conclude: "*Odontoscion australis*" is merely the juvenile stage and a synonym of *Elattarchus archidium*, one of the endemic elements in the rich sciaenid fauna of the Panamaic region.

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A Case of Poisoning by the Stonefish, *Synanceja verrucosa*

J. L. B. SMITH

AS PART of the program for a study of the fishes of the east coast of Africa, an expedition was made to the northern part of the coast of Portuguese East Africa where intensive collecting was carried out for nearly 4 months. Most of the time was spent at the Pinda Peninsula, living in a lighthouse, at about 14°12' S. latitude. Work here is perilous, as tides run to 14 feet, winds and currents are strong, storms are sudden and frequent, and in the deeper water sharks abound. The natives of the region, who have an admixture of Arab blood and a long-established maritime tradition, state that the stonefish, *Synanceja verrucosa* Bloch, is most abundant on the

great reefs of Pinda and of Serissa, the latter at 13°35' S. This fish they name "Sherova" and fear greatly, killing every one they see.

Well aware of the danger from *Synanceja*, we always wore special boots and leggings. A number of these fishes were encountered in diverse localities, and it was of interest to observe the almost perfect mimetic resemblance to the background. The heavy coating of slime on *Synanceja* results from the exudations from the very numerous skin glands (Duhig and Jones, 1928: 142). The rugged body is primarily greyish brown, but mottled in various shades of red, orange and pink, according to the locality (Smith, 1949: 374, pl. 84). This camouflage is highly successful, as every specimen examined had food in the stomach, mostly the common coral-haunting fishes, the following have been found in varying stages of digestion: *Centropyge bispinosus* Günther, *Abudefduf biocellatus* Quoy and Gaimard, and *Pomacentrus annulatus* Peters.

According to the natives, who mostly walk barefoot, the spines of this fish, if trodden on, easily penetrate even their thick soles. Despite their perpetual awareness stabs are not uncommon, as great numbers continually wade over the reef, which at slack water is often above waist deep. There is almost always wind so that visibility of the bottom may be poor. Accounts of the pattern of the consequences of a stab given by different natives agree fairly well. The pain starts almost at once and rapidly becomes intolerable, even to these people who generally seem to feel pain less than Europeans. Within 10 to 15 minutes the victim either collapses or becomes delirious and maniacal, raving and thrashing about in a boat or on the ground. If stabbed while wading, it generally takes three or four men to hold him and get him to shore without drowning. The intense agony lasts from 8 to 12 hours, after which it gradually diminishes, but the victim is weak and exhausted. Those who die generally do so within a time assessed at about 6 hours. Swelling starts soon after the stab and continues to increase for "some days." Legs may attain elephantine proportions. The degree of swelling and its duration possibly depend on the amount of toxin injected. Some victims are able to walk after 3 weeks, but mostly it is said to be "a long time" before the limb is usable. Often large blisters form, and eventually considerable areas of the skin fall off. Sometimes the dark pigment is destroyed and the skin of the blistered area remains light pink. Stabs in fingers or toes have led to the loss of those digits, which turn black and "fall off." Some persons are still "sick" as long as a year afterwards. Accounts gave no clear statistics of fatalities, only that victims sometimes die. The overall clinical picture is that of a powerful neurotoxin, and with this my own experience accords.

Our collecting was carried out with the assistance of intelligent natives, mainly sailors, whom we had trained. They were all acquainted with the danger of the various Cataphracti, abundant on the reefs. We generally had a special receptacle for poisonous fishes, while most were put in metal trays covered with cloth for protection from the sun. At tide pools we usually worked by applying poison, leaving the natives to collect the fishes as we worked from one pool to the next. On August 19, 1950, at about 3 PM a boy called out "Sherova," and was told to keep it. About half an hour later, having a tube of rarer forms in my hand and wishing to go

and inspect the catches in canoes from the outer reef, I called the nearest boy and, reaching up to the tray on his head, put the tube in it, telling him to guard it from the sun. In doing this I felt a sharp stab in my thumb, and hastily withdrew thinking it had been due to a needle in the rag, and I felt it touch the bone. As I looked at two bleeding punctures, an intense stab of pain shot up my arm to my neck. This was 5 to 10 seconds after the stab. With foreboding I made the boy bend, lifted the cloth, and there was a stonefish, contrary to orders, in the tray. Moreover it was still alive, with the 13 dorsal spines erect, the second and third free from the membrane, the third for about one-fourth of an inch. Hastily binding string tightly around the thumb, I cut across the punctures and sucked vigorously, telling an agile servant to run for my wife who was around the point. I set off for the lighthouse, sucking vigorously all the time, but before reaching the beach, only five minutes away, the pain was spreading through the hand, mainly across the knuckles, and was of an intensity never before experienced. Of the half mile through the forest to the lighthouse, a fairly steep incline, there remains little recollection save of a grim battle to remain conscious and of an insane desire to ease the mounting agony by rolling on the ground. At the lighthouse the Keeper came to help me. The hand was numb and swelling fast. We managed to sterilize a syringe, but while trying to withdraw some nupercain from the bottle, that fell and broke on the concrete floor. As I stood staring stupidly, my wife burst in and soon injected novocain. For a short time this had some effect, but the pain had by now become a searing agony, mostly across the back of the hand, with spasms reaching to the neck, head and shoulder. The perspiration was such that my wife on arrival thought someone had splashed me with water, for it dripped to the floor. According to her account during the next two hours, of which I have little recollection, I was close to collapsing several times, but managed to keep on my feet. A native witchdoctor and his wife had been summoned by the natives. The woman was chewing some green leaves. The man demanded a fresh cut which he sucked vigorously. The woman then mumbled over the hand, spat the mixture on the cut and rubbed it in. Then she called for what looked like a reddish stone and rubbed it all over the thumb. The man then announced that the pain would go in 6 hours. My wife judged it wise to wash the thumb with a disinfectant. The natives present were not all convinced of the value of the treatment applied, saying that in some cases it worked and in others not. None knew the identity of the plant or of the stone. At $2\frac{1}{2}$ hours after the stab my wife injected $\frac{1}{4}$ grain morphine sulphate subcutaneously. After about 20 minutes I felt drowsy but the drug had no apparent effect on the pain. At about $3\frac{1}{2}$ hours after the stab, the pain was undiminished and the perspiration still profuse. My wife decided to try immersion in hot water. The effect was dramatic. The agony diminished rapidly to bearable proportions, and I returned to normal consciousness and an unquenchable thirst. We continued this immersion in hot water, and I drank innumerable cups of tea for the next 4 hours, by which time the intense agony no longer recurred on removal from the hot water. In the morning the thumb was greatly enlarged, had turned black all around the area of the stabs, and was without sensation. The hand was greatly

swollen, also the lower forearm, and was intensely painful to the touch. Twenty-four hours after the stab, large yellow blisters started to form and spread rapidly over the thumb, becoming exceedingly painful, and when punctured released a serous fluid, which dripped steadily thereafter for 6 days. The swelling gradually increased, reaching a maximum after 3 days, extending somewhat above the elbow. In this time joints and weak spots, such as old wounds, ached intensely all over the body. On the 6th day inflammation and pain in the thumb increased alarmingly and pus appeared. The injection of 1,000,000 units of penicillin in 5 doses over 16 hours had a rapid and marked beneficial effect on the local condition, with retraction of the inflamed and blistered area. It is not improbable that the loss of digits in the natives is due to secondary infections of this type. Alarming symptoms of a similar type started a week later and again subsided after penicillin injection. In this warm region the slightest cut or scratch easily becomes infected, with serious results unless promptly treated.

On the 9th day some degree of sensation returned to the thumb. The blisters were subsiding and the swelling was no longer beyond the elbow. The hand was still swollen and painful. After 14 days the hand and thumb only were still swollen, but painful and unusable. After 30 days the black portions commenced to fall away leaving pink scars. The site of the cut opened to a discharging cavity and did not heal finally until 50 days after the stab. After 80 days, the hand was still weak and the thumb barely movable at the joint, being still slightly swollen and painful when moved. The toxin had a marked adverse effect on general health and condition.

Having been stabbed by an eagleray (*Myliobatis cervus* Smith) and by a barbel (*Tachysurus feliceps* Valenciennes) it is possible to say that *Synanceja* is in a class by itself. The fish which caused all this was 120 mm. long and weighed 84 grams. The largest specimen taken was 260 mm. in length and weighed 980 grams.

My experience suggests that anyone stabbed by this fish should cut deeply, suck well, and immerse the wounded limb in water as hot as can be borne. It might be advisable to inject penicillin at 24 hours and again about 4 days afterwards, or when alarming symptoms appear.

Studies of the nature of the venom of *Synanceja horrida* by Duhig and Jones (1928)¹ suggest that it is probably neurotoxic and that a hematotoxic effect was also noted. A pair of poison sacs lies near the tip of each spine and from these a duct runs along shallow, lateral grooves in each spine towards the tip. These poison sacs vary in development for they sometimes are vestigial or absent. An apparently toxic fluid is also exuded from glandular tubercles in the skin.

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RHODES UNIVERSITY COLLEGE, GRAHAMSTOWN, SOUTH AFRICA.

¹ Reference kindly supplied by Dr. Bruce W. Halstead of the School of Tropical and Preventive Medicine, Loma Linda, California—Ed.

Pupil Shape in Certain Geckos

GARTH UNDERWOOD

IT IS well known that the majority of geckos have a vertical-slit pupil, and that in many the margins of the slit bear lobes. Very little attention, however, seems to have been paid to the precise form of the pupil margins, apart from the work of a few ophthalmologists who were not concerned with the evolution and systematics of geckos. Walls (1942: 224) gives an account of the functional significance of this pupil form.

In the course of a comparative study of the gecko retina,¹ I have noted the shape of the pupil in the several available genera. Of the forms with a vertical-slit pupil the margins are straight in *Aristelliger praesignis* (Hallowell), *Hoplodactylus pacificus* (Gray) and *Sphaerodactylus parkeri* Grant (Fig. 1, a.). I have seen two patterns of vertical pupils with lobed margins.

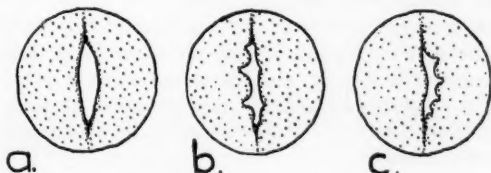


Fig. 1. Pupil shapes in geckos (right eye). a. *Aristelliger praesignis*. b. *Gehyra mutilata*. c. *Coleonyx v. variegatus*.

Phyllodactylus t. tuberculosus Wiegmann, *Gehyra mutilata* (Wiegmann), *Hemidactylus bowringi* (Gray) and *Gekko chinensis* Gray have pupils of almost identical shape: the posterior margin bears three prominent lobes, the middle one largest; the anterior margin bears three less prominent lobes (Fig. 1, b.). *Coleonyx v. variegatus* (Baird) shows a peculiar condition in that the pupil aperture has a somewhat more marked nasal displacement than that of the other forms; the posterior pupil margin bears a single, rather low lobe, and the anterior margin bears four prominent lobes. (Fig. 1, c.).

I have figured the pupil shape as seen after fixation with Kolmer's fluid. Alcohol causes serious distortion of the pupil shape, as is pointed out by Prince (1949, p.162), but formalin gives good preservation. Museum material which has first been preserved in formalin should therefore be suitable for examination of the pupil form.

Prince states that in a large number of Australasian geckos he did not see the lobed pupil margin, but mentions by name only *Hoplodactylus gran-*

¹ Underwood, 1951.

ulatus (Gray), *H. maculatus* (Gray) and *Gymnodactylus platurus* (White). The pupil in *Tarentola mauritanica* (L.) is, from Läscher's figure, like that of *Gehyra*. Boulenger (1885) figured straight edged pupils in *Nephrurus asper* Günther, *Rhynchoedura ornata* Günther and *Ptenopus garrulus* (Smith). Of the forms with straight pupil margins *Aristelliger*, *Hoplodactylus*, *Nephrurus*, *Rhynchoedura* and *Ptenopus* have a restricted distribution in what might be termed relict areas of the world. *Gymnodactylus*, on the other hand, while widely distributed, shows a primitive condition of the digits. (It should perhaps not be assumed that the genus is homogeneous and that all species show straight margins.) There is good reason to believe that *Sphaerodactylus* acquired a vertical pupil independently. The "*Gehyra*" type of pupil occurs also in *Hemidactylus*, *Tarentola*, *Gekko* and *Phyllodactylus*, all widely distributed and "successful" genera. It seems unlikely that such a pupil form would arise twice. *Coleonyx* stands on its own as regards pupil shape, but it is distinguished from other geckos in a number of other respects also, including the retention of mobile eyelids and consequent absence of a spectacle. *Hemitheconyx* and *Eublepharis* may show a similar condition.

Inadequate though these data be, there seems to be some reason for believing that geckos, apart from the eublepharid and sphaerodactyloid genera, may be divisible into two groups: (1) an older group having a vertical-slit pupil with straight margins, or retaining a primitive circular pupil (e.g., *Cnemaspis*?), and (2) a more recent group with lobed pupil margin of the form described for *Gehyra* including a number of successful and widespread genera.

As pointed out by Walls (1942: 203) some geckos are probably secondarily diurnal and have reverted to a circular pupil. *Lygodactylus* is related to *Hemidactylus* and would therefore come in the second group. *Phelsuma* is related through *Rhoptropella* to *Rhoptropus* (Loveridge, 1947: 283, 293-94). I do not know the form of the vertical pupil of the latter genus.

When more forms are examined, there may well be further complications. Material is being collected for a detailed discussion of the evolutionary and systematic implications of eye structure in geckos.

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Observations on the Habits and Life-history of the Chinese Newt, *Cynops chinensis* Gray

J. D. ROMER

ALTHOUGH first described as long ago as 1859, *Cynops chinensis* appears to have escaped, to a large extent, the attention of herpetologists; and there is still much to be investigated—even fundamental details which in many other species of the Salamandrinae are so well understood. The following observations were made in the Colony of Hong Kong during the latter part of 1947, 1948 and 1949, when the author was fortunate in being able to see the species in a wild state and obtain material for study. The sketchy nature of these observations, even as a preliminary study, leaves much to be desired, but it is hoped that no great time will lapse before other herpetologists are able to study the species in its natural state and thereby fill some of the more important gaps.

EXTERNAL CHARACTERS OF THE ADULTS

Sexual dimorphism (Fig. 1) usually makes it possible to determine the sex of a specimen at a glance. The total length of females is generally greater

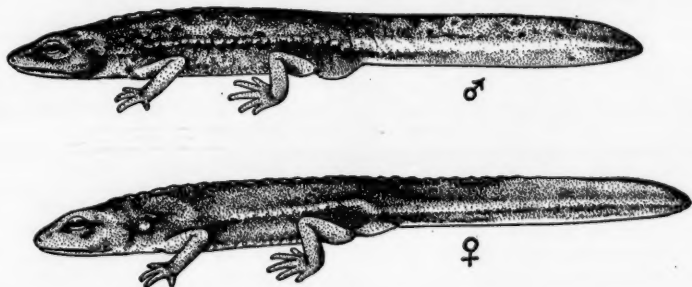


Fig. 1. Sexual dimorphism in *Cynops chinensis*, Upper, male; lower, female.

than that of males. In 14 females the total lengths ranged from 126 to 143 mm. (average 133.5); in 24 males, the range was 111 to 129 mm. (average 120). As with certain other Salamandrids the cloacal lips of the male, at least during a part of the year, are considerably more swollen than those of the female. The measurements of 12 specimens of each sex (Tables I and II) also indicate that the male has a relatively longer head and shorter tail than the female, and that there is no difference in the relative length of the limbs. Measurements of the greatest width of the tail in nine specimens of each sex indicate that it is slightly wider in the male, varying from 9 to 13 mm. (average 10.7). The range in the females was 9 to 11 mm. (average 9.7).

The exceptionally large size attained by a female taken at Shatin appears to be an instance of gigantism. Measurements of this specimen were: total length 161, head and body 86, head 26, fore limb 28, hind limb 30, and tail 75 mm.

Since it appears that little that has been published on this newt has related to live material, a few notes on the coloration of live specimens may be pertinent. The following remarks are based on nine adults and one rather small specimen, including both sexes, which were taken at Shatin on August 8, 1948. Dorsal color uniform dark olive to dark brown, the vertebral ridge faintly or distinctly orange in some; ventral coloration blackish (faintly bluish) with irregular, unequal, orange spots, rather small in some specimens and in others larger (Fig. 2); spots disposed on chin, throat, neck, thorax and belly, and small indistinct ones may be present on

TABLE I

RANGES FOR MEASUREMENTS (IN MM.) ON 12 MALES AND 12 FEMALES OF *Cynops chinensis*

Length of:	Males	Females
Total length	117-129	126-137
Head plus body	67-73	70-76
Head	20-23	20-23
Tail	49-56	55-63
Foreleg	21-26	23-26
Hindleg	22-26	23-27

TABLE II

RANGES AND AVERAGES (IN PARENTHESES) FOR RELATIVE DIMENSIONS ON 12 MALES AND 12 FEMALES OF *Cynops chinensis*

Ratio, length of:	Males	Females
Head/Head plus body	29-32 (31)	28-31 (29)
Tail/Head plus body	71-79 (75)	77-87 (83)
Foreleg/Head plus body	30-36 (34)	30-36 (34)
Hindleg/Head plus body	32-37 (34)	32-37 (34)

lower surfaces of limbs, the latter paler and sometimes mottled; lower edge of tail orange, becoming less pronounced distally; tail either dark like dorsum or lighter, sometimes distinctly mottled with orange and a darker color.

What must be considered as an aberrant specimen (Fig. 3), at least as far as material from the Colony of Hong Kong is concerned, was collected by the author from a stream on Kowloon Peak on November 6, 1948. The dorsal coloration was dark brown intermixed with pale yellowish-brown, producing a rather patchy appearance. The ventral aspect was the more abnormal, however; the usual blackish ground color being replaced by pale orange, with typical bright orange spots discernible. Two dark brown markings on the throat and another near the vent were also unusual. The tail was mottled with orange and brown with its lower edge bright orange as in typical specimens.

A pale lateral band on the tail, of varying width and intensity, has been observed frequently in males, although as yet the development of this characteristic has not been correlated with seasonal or other changes.

HABITS AND HABITAT

The author has either personally collected or received specimens from near Wongneichong Reservoir on Hong Kong Island, and Shatin, Ho Chung and Kowloon Peak on the mainland. Other localities, at which newts have been reported to the author by reliable observers, are Mount Parker on Hong

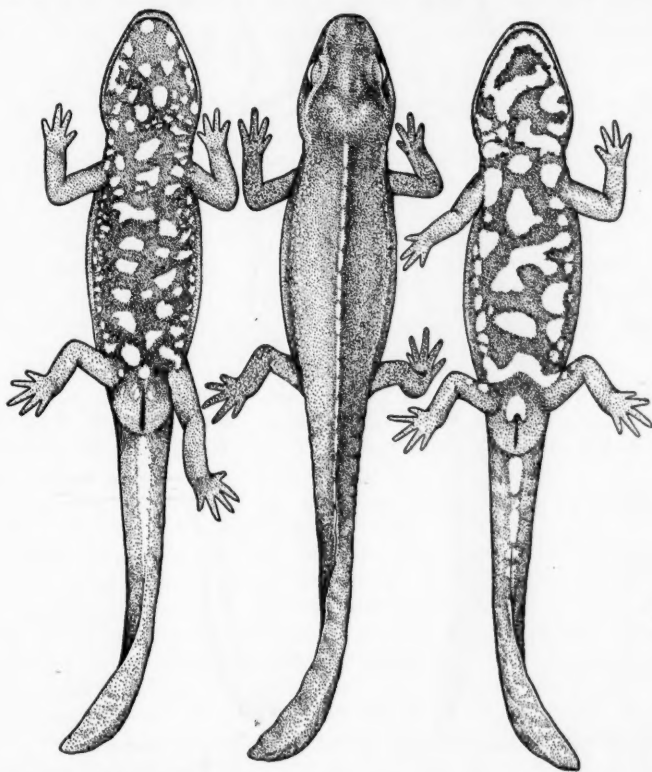


Fig. 2. Color patterns in *Cynops chinensis*.

Kong Island and above Jubilee Reservoir on the mainland. All were found in small streams in the hills at elevations estimated to range from 800 to at least 1,500 feet. Not a single specimen appears ever to have been found at sea level or at any elevation much below 1,000 feet. At about 1,500 feet on Kowloon Peak they were abundant.

The nature of the habitat in the Colony of Hong Kong does not show any marked variation. On Kowloon Peak on November 6, 1948, about two

dozen specimens were collected at a point where the stream was only a few feet in width; the water was shallow and the current was not strong. The numerous stones ranging from pebbles to boulders afforded an abundance of cover in the stream-bed for small aquatic animals. Further cover was provided by aquatic plant life, and by terrestrial vegetation growing up to, and overhanging the water's edge. Another small stream at Ho Chung visited on January 2, 1949, however, presented a habitat devoid of aquatic

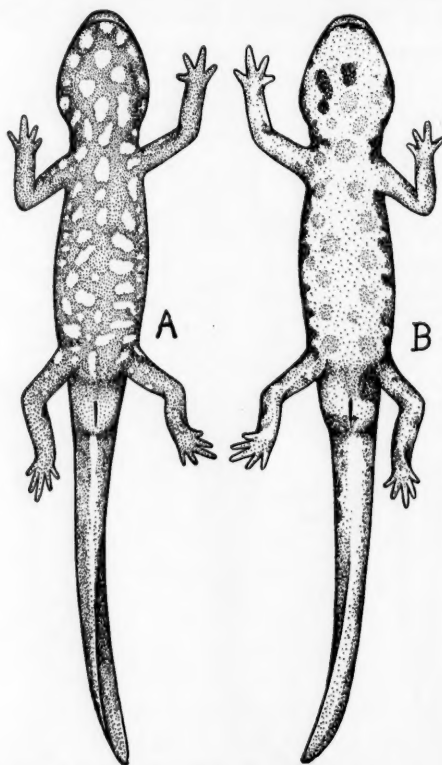


Fig. 3. Color pattern in *Cynops chinensis*. A. Typical; B. Aberrant.

plants. Stones were again numerous, and together with terrestrial vegetation, provided cover for the newts which were found to be quite plentiful. At the place visited this stream, too, was shallow, except immediately below a waterfall where there was a small but very deep pool. Here one newt was observed to swim from the shallow water down into the depths.

The distribution and habitat of *Cynops chinensis* are discussed by Boring (1934) and Pope and Boring (1940). The range of the species, as known at present, includes two limited isolated areas: one in the northeast in Anhwei and Chekiang; the other in the south, including Hong Kong Island

and the adjoining mainland, as referred to above. It would seem, therefore, that much further observation is necessary to establish the actual extent of the range. With regard to the habitat in the northeast, Boring (1934) remarks that: "In Chekiang, it is found in large streams in populous regions, not in isolated cold mountain brooks, . . ." Pope and Boring (1940) say that: "The habitat preference of *chinensis* is also distinctive, as it is always found in rapid streams at the base of mountains, rather than in quiet ponds." It is evident, therefore, that streams are the normal habitat and not pools or other collections of static water. As already pointed out, however, it appears never to occur at the *base* of mountains in the southern part of its range; its occurrence at higher altitudes there, and at lower altitudes in the northeast, presumably is due to the normal geographic relation in north-south distributions.

It appears that there is no knowledge whatever as to whether this species becomes, to any extent, terrestrial in its habits. The author cannot do more than mention a few scanty observations which may eventually help to solve the question when more data are available. Adults have been found in the water in a natural state in January, April, May, July, August, October and November, but very few or no visits were made during other months. Some specimens can probably be found in the water at any time of year. Adult Chinese newts have been kept by the author in an ordinary small glass aquarium for several months. While individuals so kept usually appeared at ease when forced to remain in the water, some would leave the water if an island were provided.

Feeding in captivity took place both in and out of the water. Although individual bloodworms were taken readily, tubificids were accepted only in aggregations of a suitable size. The lowest temperature recorded at which feeding took place was approximately 15° C.

Sloughing was observed only once and occurred in the water, the salamander promptly swallowing its cast-off skin.

What few data the author has been able to obtain indicate that the main breeding season probably takes place during the cool weather (from November to April in Hong Kong). Courtship was seen only once and took place in the aquarium on December 29, 1948. The male's tail was folded, and vibrated as it does in other aquatic Salamandrids. A collection of several dozen specimens offered for sale by an aquarium dealer had started to lay, and several were laden with eggs when seen on February 21, 1948. A female with the body much distended with eggs was taken from a stream on Kowloon Peak on November 14, 1948. Twelve others from the same place were taken on April 20, 1949 and were dissected. In five no ripe or ripening ova could be seen; in another five there were not more than a few fairly large and/or ripe ova in each; and in two there were quite a number of fairly large and/or ripe ova in each. It seemed, therefore, that egg-laying had mostly finished.

OVIPOSITION AND THE OVA

A female, heavily laden with eggs, was purchased from a local aquarium dealer on February 21, 1948. A few days later it was placed in a cylindrical

glass jar $9\frac{1}{2}$ inches deep by 8 inches in diameter, filled with water to a depth of about 7 inches and provided with a layer of sand, a piece of stone, and some aquatic plants. Eggs were first observed on February 29 and oviposition then continued for almost three weeks, after which, on March 23, the specimen was found dead. The cause of death was not established. Throughout oviposition, periodical counts were made so as to gain some idea of the rate at which eggs were being deposited; and, although it could not be arranged to count at the same time each day, counting was done at intervals of about 24 hours, the temperature of the water at the time being noted (Table III).

TABLE III
PROGRESS OF OVIPOSITION BY A SINGLE FEMALE CHINESE NEWT

Date	Time	Total number of eggs laid	Temp. to nearest °C.
Feb. 29	2:45 PM	7	24
March 1	9:45 PM	18	22
" 3	12:20 AM	43	18
" 3	11:15 PM	54	18
" 4	10:30 PM	62	19
" 5/6	Midnight	62	20
" 7	1:15 AM	65	21
" 7	10:00 PM	75	22
" 9	12:20 AM	90	22
" 9	10:00 PM	90	23
" 10	10:00 PM	90	24
" 11	10:30 PM	93	24
" 12	10:00 PM	101	25
" 13	11:30 PM	101	25
" 14	10:30 PM	102	26
" 17	10:00 PM	112	23
" 18	10:00 PM	114	21
" 19/20	Midnight	115	22
" 23	10:00 PM	115	20

Of the total number of eggs, 78 percent were deposited during the first ten days and 22 percent during the last ten days.

The female's *modus operandi* during oviposition appears to be typical of the European newts of the genus *Triturus*. With her hind feet she presses together the leaves of aquatic plants around the eggs as they are laid. However, many of those deposited by the individual mentioned above were not attached to plants or other objects, but rested freely on the sand, both singly and in groups.

The vitellus is approximately 3 mm. in diameter, the upper hemisphere brown, and the lower a very pale (whitish) color. This is enclosed in an inner gelatinous covering which in turn is contained within a similar outer capsule measuring approximately 6 by 4.5 mm.

Of the 115 eggs referred to above, 33 had been removed for preservation and five had deteriorated by the time the first larva hatched on March 25. By April 11, six more had been preserved, and with the exception of about

six, all those remaining had hatched. The incubation period thus appears to have been about three to four weeks.

THE LARVAE

The total lengths of eight newly hatched larvae were found to vary between 10 and 14 mm., with an average of 13 mm.

Descriptive details, from one live larva out of the above-mentioned batch of eggs, were recorded on September 4, 1948. Total length 40 mm.; head longer than broad, depressed, 5.5 mm. in greatest width; snout blunt; distance between eyes greater than between eye and tip of snout; body compressed; tail pointed, upper crest extending onto dorsum, lower crest as far as vent; head and body black above; tail, especially crests, not so dark as body when looked at against the light; belly black with irregular pale yellow spots; lower surfaces of head and limbs paler, with faint traces of pale yellow on former; proximal half of lower edge of tail also partly pale yellow; pigment absent from margin of upper crest; gills pinkish, with patches of black on anterior surface, patches more evident toward base; iris golden; horizontal black bar through center of iris and pupil.

The first specimen to metamorphose left the water on October 11. Details regarding dates of metamorphosis of the others were not recorded, but it was noted that the young appeared to become entirely terrestrial immediately after metamorphosis. They were not kept alive for any length of time because of the difficulty of providing food.

Five larvae taken from a stream on Hong Kong Island were received on April 28, 1949 and measured from 33 to 35 mm. in total length. They were nearing metamorphosis, and the gills of two had started to degenerate. The tips of their snouts were pale (yellowish) between the nostrils, a characteristic observed in other specimens. It is possible that these were from eggs laid late during the previous breeding season (i.e., late March or early April, 1948) and had overwintered.

ACKNOWLEDGMENTS

The author wishes to express his gratitude to Mr. L. A. Lantz of Manchester, England, and Mr. H. W. Parker of the British Museum (Natural History) for valuable information and guidance. He wishes also to thank Mr. Tang Ying Wei for preparing the text figures and his several other friends in Hong Kong, particularly Mr. C. T. Large, for kind assistance in visiting various localities and obtaining material for study.

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The Distributional Implications of Temperature Tolerances
and Hemoglobin Values in the Toads *Bufo marinus*
(Linnaeus) and *Bufo bocourti* Brocchi

L. C. STUART

DURING the course of some 20 years of herpetological investigations in Guatemala, I have been impressed by the faunal break that is so obvious in the neighborhood of the 1500 m. contour. I have been led, in fact, to recognize two major herpetological assemblages in the country, highlanders as opposed to lowlanders, the common boundary of which approximates that isopleth. During 1947, efforts were made to examine several physiological qualities in two species of *Bufo*, typical of this vertical pattern, that might account for their zonal restrictions. Though increasing "altitude" carries many environmental implications, decreasing temperature and reduced partial oxygen pressure of the atmosphere seemed especially suggestive as limiting factors, and investigations into two physiological qualities associated with these conditions, temperature tolerances and hemoglobin values, were undertaken.

Because of their high degree of tolerance to environmental conditions within their respective ranges, their abundance, and their geographic and systematic isolation one from the other, the lowland *Bufo marinus* (Linnaeus) (*s.l.*) and the highland *Bufo bocourti* Brocchi were selected for study. *Bufo marinus*, or some variant thereof, is distributed throughout the American tropics from the United States to Argentina. It is tolerant to environments that run the gamut from tropical rain forest to desert. Its upper limit in Guatemala is about 1500 m. *Bufo bocourti*, in contrast, is known only from the plateaus of Guatemala and Chiapas, México, where it, too, shows a high degree of tolerance to local microenvironments. Its vertical limits extend from 1700 m. to possible 3600 m. Since both species are essentially nocturnal, the following discussion will consider their physiological functions in relation to nocturnal environmental conditions. Throughout this paper temperatures are given in degrees centigrade, elevations in meters, weights in grams, and lengths in millimeters.

I take this opportunity to express my thanks to Mr. A. L. Bump, manager of the Tiquisate Division of the United Fruit Company in Guatemala, and to his staff, especially the company veterinarian, Dr. Marion Cox, for the many courtesies shown me during my sojourn in the Tiquisate region. Doctors Lee R. Dice and Charles F. Walker, both of the University of Michigan, have offered me many suggestions and aided me with literature connected with this study, and Dr. Charles M. Bogert of the American Museum of Natural History has reviewed my data critically. For their constructive criticisms I am sincerely grateful. Dr. Cecil C. Craig of the University of Michigan aided in the statistical analysis of the data contained herein. Financial support for my studies in Guatemala during 1947 was supplied by the Horace H. Rackham School of Graduate Studies.

TEMPERATURE AND TEMPERATURE TOLERANCES

An effort was made to determine the temperature thresholds to two critical conditions. These, utilizing the definitions of Cowles and Bogert (1944: 277-278), were:

Critical minimum—"At this temperature the animals are helpless to escape enemies or to remedy their thermal impasse . . ."

Critical maximum—"This . . . may be defined as the thermal point at which locomotory activity becomes disorganized and the animal loses its ability to escape from conditions that will promptly lead to death."

Critical minimum temperatures were obtained at Ixchiguán, Department of San Marcos (elevation 3200 m.), utilizing native representatives of *Bufo bocourti* from Ixchiguán, and *Bufo marinus*, secured seven days prior to the experiments from Tiquisate, Department of Escuintla (elevation 85 m.). In these experiments the subjects were merely observed at different air temperatures or warmed by placing in the sun. Though on the basis of the work of Colbert, Cowles, and Bogert (1946: 9-10) on the American alligator it could be assumed that body temperatures approached those of shaded air temperatures, some body temperatures were taken by enclosing a 12-inch Taylor thermometer in the axilla.

Critical maximum temperatures were secured on *Bufo marinus* at Tiquisate and Puerto Barrios, Department of Yzabal, at sea-level and upon *Bufo bocourti* at Ixchiguán. Only native stocks were used. The subjects were placed uncrowded in standard, 5-gallon gasoline tins in which were maintained water levels just deep enough to permit the subjects to touch bottom. Starting with water of temperatures close to those of the natural aquatic environment, the temperature was gradually increased through the addition of hot water at a rate of about 3° every 15 minutes until critical temperatures were approached. At that stage the temperature was increased at a rate of but 1° per 15 minutes. It was assumed that body temperatures closely approximated those of the medium.

My data indicate that the critical minimum of adult *Bufo bocourti* lies below 3.5°. At that temperature the species was frequently observed during the evenings, hopping about presumably in search of food. A male and female in amplexus were removed from a freshet the temperature of which was 14° and placed in a dry tin overnight. The air temperature during the night fell to 4.5° yet the two remained in amplexus and the female deposited eggs. Tadpoles of the species, on the other hand, are probably never subjected to temperatures lower than 10°, since the coldest water temperature I have ever encountered in Guatemala was 13.5° at 3200 m. In freshets and pools at that temperature, both egg masses and tadpoles were observed throughout a good share of the year.

Repeated observation on six specimens of *Bufo marinus* indicates that the species attains its critical minimum in the neighborhood of 15°. With axillary temperatures at 7°, the subjects were unable to right themselves when placed upon their backs. At 10° they would right themselves, while

at 12° they hopped when prodded. After some 20 minutes warming in the sun, axillary temperatures rose to 18°, and, though showing little activity as a group, they would hop voluntarily. It seems probable, however, that in this last instance internal body temperatures lagged behind axillary temperatures.

Critical maximum experiments were conducted upon 24 subjects of *Bufo marinus* varying in weight from 30 to 240 g. and upon 11 subjects of *Bufo bocourti* whose weights were estimated to vary from 20 to 40 g. As the individuals of each species were subjected to increasingly higher temperatures, they displayed a remarkable uniform response pattern. Once apparently optimum temperatures had been exceeded, escape efforts were made. This reaction was followed by a quiescent stage during which the subjects floated with lungs inflated on the surface of the water. As critical temperatures were attained the individuals continued to float but with lungs collapsed and with heads submerged. The conclusion of this stage was judged to represent the critical maximum condition and it was followed by a loss of orientation and the onset of heat rigor. Lethal conditions were heralded by a more advanced stage characterized by the loss of muscle tonus.

The time-temperature relationship for the attainment of the critical maximum differs in the two species (Figs. 1 and 2). The least tolerant

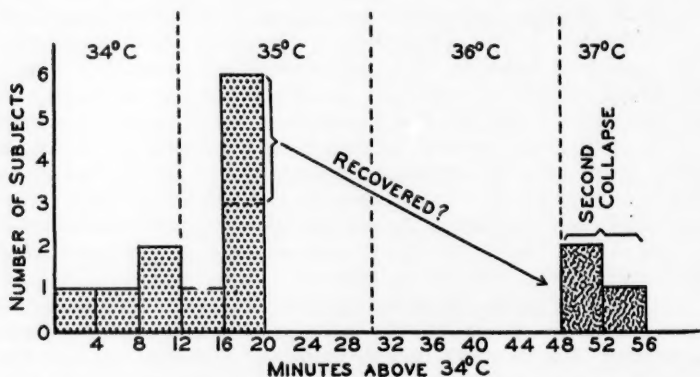


Fig. 1. Temperature-time relationship for the attainment of the critical maximum temperature in *Bufo bocourti*, plotted at 4-minute intervals.

individual of *Bufo bocourti*, a female that had been in amplexus for 24 hours prior to the experiment, attained its critical maximum after only one minute at 34° and 76 minutes after the experiment had been begun with a starting temperature of 13°. The most resistant individual, on the other hand, reached its critical maximum at 37° after 55 minutes at temperatures above 34°. I am unable to explain the apparent recovery of three individuals from a helpless state that had been reached at 35° and a second collapse at 37°. It is most probable that the first collapse was misinterpreted.

Nevertheless, *Bufo bocourti* on the average probably attains its critical maximum at temperatures of from 34° to 35°.

The least resistant individual of *Bufo marinus* attained the critical maximum after only four minutes at 41°, while the most tolerant was able to withstand six minutes at 42° and a total of 21 minutes at temperatures above 41°. In several, 41° proved to be lethal. Thus *Bufo marinus* displays a much narrower range of tolerance to critical maximum than does *Bufo bocourti*.

Though larger individuals of *Bufo bocourti* as a group appeared to be most tolerant to high temperatures, the smallest individual tested proved the hardest and one of the largest the least resistant. In *Bufo marinus*, individuals of moderate size proved to be the most tolerant. Generally speaking, in those experiments in which the temperatures of *Bufo marinus* were

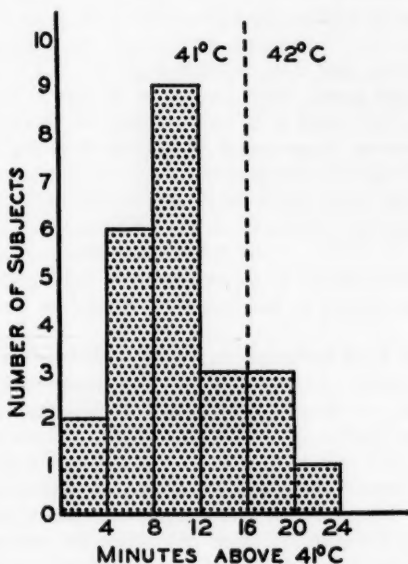


Fig. 2. Temperature-time relationship for the attainment of the critical maximum temperature in *Bufo marinus*, plotted at 4-minute intervals.

raised from 27° or 28° to the critical maximum, the subjects proved somewhat more resistant than those in which 32° or 33° was taken as a starting point. This suggests that a gradual acclimatization might greatly alter the critical maximum temperature of both species.

The foregoing scanty data are at best merely suggestive. If reduced temperature is a factor in determining the upper limit of *Bufo marinus*, nocturnal temperatures of the environment must be considered, since the species is essentially nocturnal in habits. The species' upper limits, there-

fore, might be expected to approximate the isopleth for the mean minimum temperature (generally nocturnal) of 15° , the critical minimum of the species. Scattered climatological records (Ward, Brooks, and Conner, 1938; and Reed, 1923) indicate that in Guatemala the mean minimum isotherm of 15° is roughly coincidental with the 1500-m. contour during the high sun period and somewhat lower during the low sun period. Since that contour represents the approximate upper limit of *Bufo marinus* in Guatemala, temperature could be a most important factor in restricting the species to lower elevations.

Conversely, mean maximum temperatures of about 34° might be expected to determine the lower limit of *Bufo bocourti*. This does not, however, take into account the possibility of thermoregulation in the species. Kirk and Hogben (1946), for instance, have shown that, through evaporation, *Bufo bufo* can maintain a body temperature of from 1.1° to 10.2° below air temperatures at relative humidities that vary from 90 percent to 20 percent respectively. Furthermore experiments by Davenport and Castle (1896) on *Bufo* sp. and data assembled by Brues (1927) indicate that acclimation might permit *Bufo bocourti* to withstand temperatures much higher than those to which it is least resistant in short-time experiments. Finally, though water temperatures in possible breeding sites do surpass 34° in many instances on the Guatemalan lowlands, there is an abundance of pools and small lakes which never attain such high temperatures, and nocturnal air temperatures of 34° on the lowlands would be most unusual. Though nothing is known of the temperature tolerance in the tadpole of *Bufo bocourti*, there seems to be no reason to believe that adults of the species could not survive at low elevations insofar as temperature is concerned.

On the other hand literature on various cold-blooded species suggests that other temperature thresholds might restrict the lower limits of *Bufo bocourti*. Cowles and Bogert (1944) have shown that, though *Xantusia vigilis* can survive short exposures to temperatures as high as 45° , continued exposure to temperatures in the high 30's produces high mortality; and Cowles and Burleson (1945) discovered that sterility is produced in the same species at temperatures 7° - 9° below the lethal maximum. Moore (1942) demonstrated that the range of temperature tolerance of the eggs of *Rana catesbeiana* is less than half that of the tadpoles and adults, and that the development of the eggs of populations of *Rana pipiens* from cold environments is inhibited by temperatures higher than those to which the populations are normally subjected. Finally Witschi (1928) has recorded a complete sex reversal in developing females of *Rana sylvatica* maintained at near-lethal temperatures.

The implications embodied in any one or all of the above data are obvious. It is not improbable that temperatures as much as 10 degrees below the critical maximum of *Bufo bocourti* could so upset its normal life history and breeding functions that it could not survive. The 1500-m. contour in Guatemala, interestingly enough, coincides roughly with the high-sun mean maximum isotherm of 25° and of 28° in some areas.

PARTIAL OXYGEN PRESSURE AND HEMOGLOBINS

The Sahli Acid-Hematin Test was employed in all hemoglobin measurements. Blood was secured by breaching the subclavian artery, care being taken to avoid dilution of the blood by lymph concentrated in the glands in the axillary region. Estimates of grams and hemoglobin per 100 cc. of blood were made to the nearest 0.25 g. five minutes after hemolysis.

Though 264 measurements were made on as many individuals, many were made before my procedure was standardized, and even then technique failures were encountered. Only 167 strictly comparable measurements, therefore, are considered herein. These include tests upon 79 specimens of *Bufo marinus* secured at Tiquisate; and 88 specimens of *Bufo bocourti* of which 30 stemmed from Ixchiguán, 40 from Tejutla, Department of San Marcos (elevation 2500 m.), and 18 from Momostenango, Department of Totonicapán (elevation 2200 m.).

Inasmuch as McCutcheon (1936) has shown that hemoglobin in *Rana catesbeiana* undergoes considerable ontogenetic change, comparisons were made between the hemoglobin values of juveniles and adults of *Bufo bocourti* (no juveniles of *Bufo marinus* could be secured). Analysis of these data

TABLE I
COMPARISON OF HEMOGLOBIN VALUES (Hb) IN SAMPLES OF APPARENTLY HEALTHY, ADULT
POPULATIONS OF *Bufo marinus* AND *Bufo bocourti*
MEANS FOLLOWED BY STANDARD DEVIATION OF THE MEANS (STANDARD ERROR)

Function	<i>Bufo marinus</i>	<i>Bufo bocourti</i>
Number of specimens	72	76
Range Hb	6.50-11.00	7.50-13.75
Mean Hb	8.66±.128	10.57±.153
Standard deviation Hb	1.082	1.334

revealed that hemoglobin values were 18 percent higher in adults than in juveniles, a difference that was statistically highly significant. Subadults have, accordingly, not been included in the following comparisons. On the other hand only a slight difference, barely significant at the five percent level, was discovered in adults of *Bufo marinus* varying in head-body length from 69 to 140 mm. and in weight from 26 to 294 g. Once maturity has been attained, therefore, age, as indicated by length-weight correlations, may be disregarded as a factor influencing hemoglobin values. Sex could be determined with certainty only in *Bufo bocourti*, but in this species no significant sexual difference in hemoglobin values was evident. Furthermore no significant difference was found in the hemoglobin values of adults of *Bufo bocourti* secured at elevations ranging from 2200 m. to 3200 m. In man, according to Hurtado, Marino, and Delgado (1945: Chart 12), there is a mean increase of some six percent in hemoglobin values between the same two elevations. The following conclusions, therefore, are based upon data secured from measurements of hemoglobin values of 79 individuals of *Bufo marinus* and 76 individuals of *Bufo bocourti* (Fig. 3 and Table I).

It will be noted that seven specimens of *Bufo marinus* (Fig. 3) are considered anemic. Analysis reveals that, if the 79 individuals examined rep-

resent an unbiased sample, we might expect 6.48 specimens with hemoglobin values less than 6.50. On the other hand if the same seven specimens are abnormal, analysis of the data for the remaining 72 individuals reveals that the probability of finding specimens with hemoglobin values less than

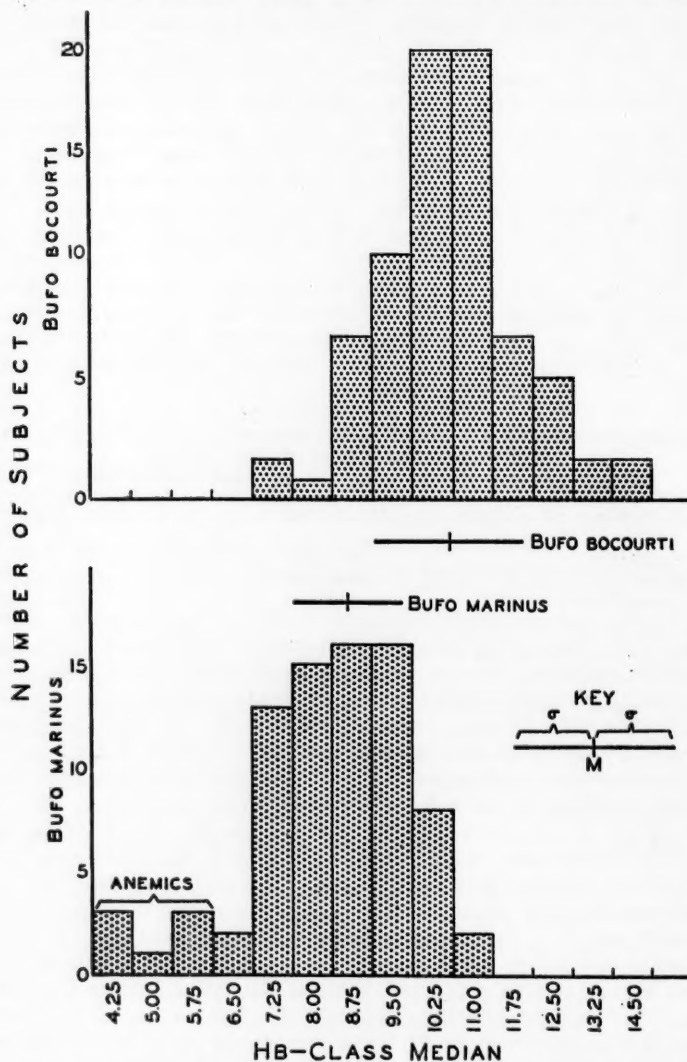


Fig. 3. Histograms of the distributions of the frequency of hemoglobin values in adult populations of *Bufo marinus* and *Bufo bocourti*. The short vertical lines between the two graphs are mean values and the horizontal lines indicate one standard deviation on either side of the means.

6.50 would be less than 1 in 100. Because of the uncertainty in the status of these seven individuals they have been eliminated from further consideration.

These data fit closely the observations of Alder and Huber (1923: 14-17) who demonstrated that hemoglobin values in a bufonid, a hylid, and a microhylid of the European lowlands ranged from 7.5 to 13.5 as contrasted with a range of from 14.25 to 15.5 in the alpine *Bombinator pachypus* (= *Bombina variegata* subsp.). Unfortunately, owing to a lack of data relating to oxygen dissociation curves, respiratory and pulse rates, relative heart sizes, and other features associated with the respiratory function, interpretation of the above data is difficult.

Assuming other factors to be equal and considering oxygen supply alone, it can be shown that an increase in hemoglobin would benefit *Bufo bocourti* were its hemoglobin identical to that of *Bufo marinus*, i.e., possessed of a coincidental dissociation curve. Increased altitude brings about a reduction both in temperature and in partial oxygen pressure. The former greatly decreases the tension of loading of the hemoglobin with oxygen, which in *Rana esculenta* amounts to about 2.5 over 10° (Macela and Saliskar, 1925). Thus at 2200 m., the lowest level at which *Bufo bocourti* was tested and where nocturnal temperatures approach 15°, the hemoglobin of *Bufo marinus*, normally subjected to nocturnal temperatures of about 25° at sea-level, could be saturated with oxygen at one-third the partial oxygen pressure prevailing at sea level, were the coefficient of *Rana* applicable to *Bufo*. But at 2200 m. the partial oxygen pressure is reduced only 25 percent below that of sea-level. Thus the reduction in temperature would more than compensate for any reduction in partial oxygen pressure at 2200 m. and, insofar as saturation of the hemoglobin with oxygen is concerned, there would be no need for an increase in hemoglobin.

At the same time, however, the tension of unloading is similarly reduced at lower temperatures, so that only very small quantities of oxygen can be transferred to the tissues. Only an increase in hemoglobin could balance the oxygen carrying capacity of the blood at higher elevations. Thus while in warm-blooded animals an increase in hemoglobin is required to supply the deficit in percent saturation of the hemoglobin with oxygen at high elevations, a similar increase in cold-blooded organisms is required to balance the reduced oxygen tension in saturated arterial blood. According to Barcroft's estimates (1925: 112) a six percent increase in hemoglobin is required for normal functioning of man at 2200 m., a figure that has since been found to obtain in peoples living at that elevation (Hurtado, Marino, and Delgado, 1945: Chart 12). The mean 22 percent superiority in the hemoglobin value of *Bufo bocourti* over *Bufo marinus* would be sufficient to insure normal oxygen supply in man at 4000 m.

On the other hand there is considerable evidence to suggest that the hemoglobins of the two species may not be identical. McCutcheon (1936) has shown that the oxygen dissociation curve of the tadpole of *Rana catesbeiana* lies well to the left of that of the adult, and McCutcheon and Hall (1937) discovered that the curves of essentially aquatic adult frogs are

similarly placed in relation to the curves of more terrestrial toads. This situation suggests a response to the lower partial oxygen pressures encountered in the aquatic environment.

Furthermore Macela and Saliskar (1925) have shown that the oxygen dissociation curve of the hemoglobin of man functioning at 35° coincides with that of *Rana esculenta* at 15°. From this, Krogh (1941: 97) concluded that "... hemoglobins are adapted to the temperature at which they have normally to function." We might suspect, therefore, that the curve for *Bufo marinus* at about 15°, the nocturnal temperature of its upper limit, might coincide with that of *Bufo bocourti* at possibly 5°.

Finally, were the hemoglobins of the two species identical, normal curves constructed on the basis of the data at hand would reveal that 88 percent of the individuals of *Bufo marinus* possess hemoglobin values as high as do 79 percent of the individuals of *Bufo bocourti*. Thus, insofar as oxygen supply is concerned, a major share of each species could survive under partial oxygen pressures encountered by the other.

If the hemoglobin of *Bufo bocourti* is specially adapted to functioning at low temperatures, there is the possibility that the species could not invade low elevations. Unless increased partial oxygen pressure of the atmosphere at elevations below its normal range were to compensate for reduced affinity of its hemoglobin for oxygen at higher temperatures of low elevations, the percent oxygen saturation of its hemoglobin would be greatly reduced.

CONCLUSIONS

In conclusion and in way of summary it is indicated that:

1. Since the adult *Bufo marinus* attains its critical minimum threshold temperature in the neighborhood of 15° as compared with less than 3.5° in *Bufo bocourti*, there is an excellent probability that this factor alone restricts *Bufo marinus* to elevations below 1500 m. in Guatemala.

2. Although the critical maximum temperature threshold of adult *Bufo bocourti* is about 35° as compared with 42° in *Bufo marinus*, this condition, except possibly through some indirect effects upon pre-adult stages, does not preclude the invasion of lowland areas by *Bufo bocourti*.

3. On the basis of our present knowledge it is impossible to draw any zoogeographic conclusion from the observed mean 22 percent superiority in the hemoglobin values of *Bufo bocourti* over *Bufo marinus*. It is suggested, however, that should the hemoglobins of the two species prove identical in their affinity for oxygen, the highland *Bufo bocourti* would definitely benefit from such an increased supply of hemoglobin. On the other hand, data on other anurans seem to indicate that the hemoglobins are not identical, in which case the increased hemoglobin values would not greatly benefit *Bufo bocourti*.

4. There is a possibility that, if *Bufo bocourti* developed in the highlands from a lowland ancestor, its initial invasion of the uplands may have resulted in an increase in the hemoglobin in the species. A modification of that hemoglobin to adapt it to functioning more efficiently at reduced temperatures and reduced partial oxygen pressures may then have followed.

As a concluding remark, attention may be called to the fact that, though

we are possessed of considerable data on the hemoglobin values of a number of species of anurans, we know practically nothing of the nature of those hemoglobins or of other features associated with the respiratory functions of that group, especially as related to their vertical distributions.

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INSTITUTE OF HUMAN BIOLOGY, UNIVERSITY OF MICHIGAN, ANN ARBOR,
MICHIGAN.

Anuran Remains from the Miocene of Florida, with the Description of a New Species of *Bufo*

J. A. TIHEN

IN THE course of removing matrix from mammalian fossils collected in the Thomas Farm deposits of northern Florida, a number of fragmentary and dissociated anuran remains have been recovered. Through the kindness of Dr. Paulo E. Vanzolini and Dr. A. S. Romer, of the Museum of Comparative Zoology at Cambridge, Massachusetts, I have been allowed to examine these specimens. I am indebted to them for this courtesy, and am further indebted to Dr. Vanzolini for other valuable aid in the preparation of this report. I also wish to express my gratitude to Dr. Edward H. Taylor, of the University of Kansas Museum of Natural History, for making available comparative skeletal material and for numerous helpful criticisms.

The recovered remains consist primarily of fragmentary limb bones, with some pectoral and pelvic girdle elements and a few vertebrae. At least two, and probably three or more, forms are represented, but only one of these can be characterized with any degree of exactness. A great majority of the specimens in the collection appear to belong to a single form; these specimens resemble very closely the corresponding elements in Recent members of the genus *Bufo*. Despite the absence of cranial elements showing certain of the commonly used diagnostic characters of the genus, this similarity is so marked, and comparisons with skeletons of a wide variety of other living genera so consistently show differences of one sort or another, that there can be little question that this fossil form is an early member of the genus *Bufo*, to which may be assigned the name,

Bufo praeivius, sp. nov.

TYPE.—MCZ No. 1991, the distal 13 mm. of a right ilium (Pl. I, Figs. 1-2).

HORIZON AND TYPE LOCALITY.—The Thomas Farm deposits of Gilchrist County, Florida; of Lower or Middle Miocene age. Remarks concerning the correlations of these deposits will be found in the discussion.

REFERRED MATERIAL.—Eight ilia (MCZ No. 1992); two tibio-fibulae (No. 2000); five humeri (No. 2002); three urostyles (No. 1995); one femur (No. 2005); one atlas and three other presacral vertebrae (No. 1996). In addition, eighteen radio-ulnae (No. 1997), seven coracoids (No. 1998), and two scapulae (No. 1999) may belong to this form, or quite possibly represent more than one form; these and a number of miscellaneous very fragmentary pieces in the collection are so lacking in diagnostic characteristics as to make any definite reference impossible.

DIAGNOSIS.—A Miocene *Bufo* with a relatively round-shafted ilium; ilium without any dorsal crest; ilial prominence low; curvature of ilium moderate.

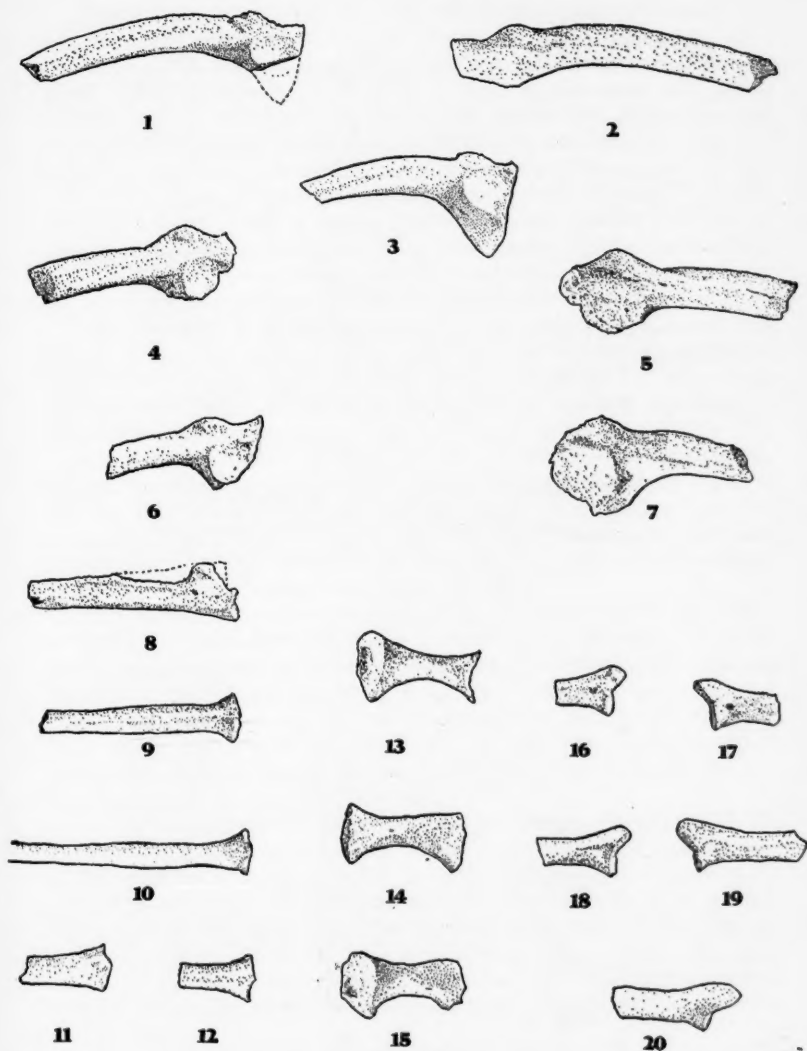


PLATE I

1. *Bufo praeivius*, type specimen, lateral aspect. 2. Same, medial aspect. 3. Portion of ilium of *Bufo t. terrestris*. 4-7. Ilii referred to *B. praeivius* (MCZ No. 1992). 8. Urostyle referred to *B. praeivius*, lateral view (MCZ No. 1995). 9. Same, ventral aspect. 10. Ventral aspect of urostyle of *B. t. terrestris*. 11-12. Urostyles referred to *B. praeivius* (MCZ No. 1995). 13-15. Coracoids probably referable to *B. praeivius* (MCZ No. 1998). 16-20. Radio-ulnae probably referable to *B. praeivius* (MCZ No. 1997). (All figures approximately $1\frac{1}{2}$ times natural size.)

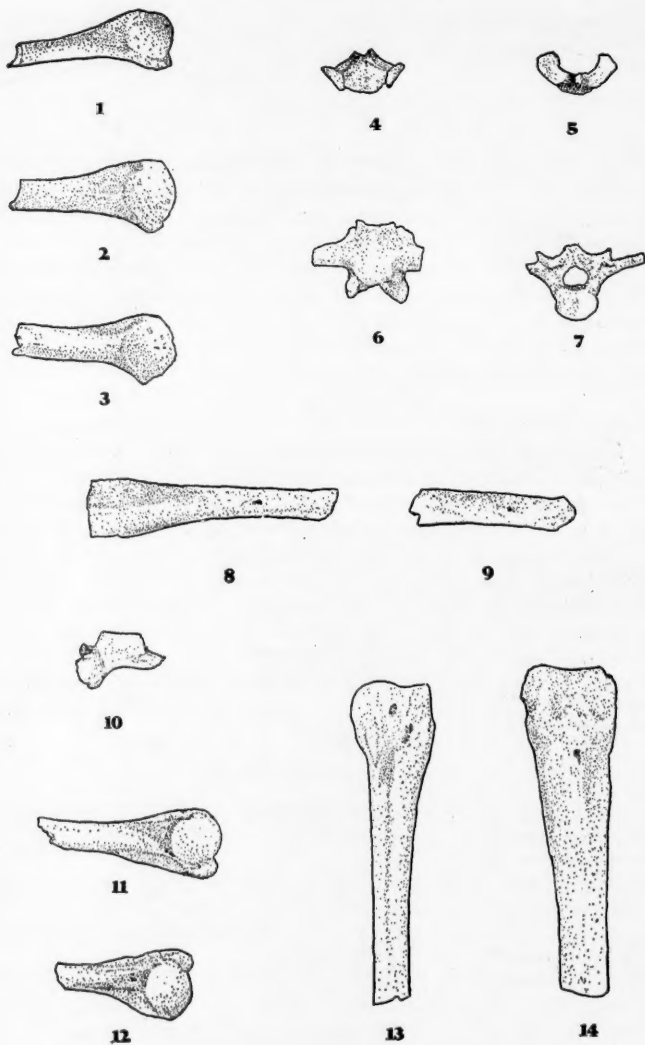


PLATE II

1-3. Humeri referred to *B. praeivius* (MCZ No. 2002). 4. Dorsal aspect of atlas referred to *B. praeivius* (MCZ No. 1996). 5. Same, anterior aspect. 6. Presacral vertebra referred to *B. praeivius*, ventral aspect (MCZ No. 1996). 7. Same, posterior aspect. 8-9. Tibio-fibulae referred to *B. praeivius* (MCZ No. 2000). 10. Fragmentary ilium, tentatively referable to *Rana* (MCZ No. 1994). 11-12. Humeri tentatively referable to *Rana* (MCZ No. 2003). 13-14. Tibio-fibulae tentatively referable to *Rana* (MCZ No. 2001). (All figures approximately $1\frac{1}{2}$ times natural size.)

DESCRIPTION AND COMMENTS.—The ilia show no marked tendency towards a lateral compression. The ilial prominence is low and sloping, comparable to that in *Bufo terrestris* and *B. valliceps*, rather than the high, steep, almost spike-like prominence of many members of the genus, such as *B. cognatus* and *B. compactilis*. It is uncertain whether this feature has any super-specific taxonomic significance, but it may be noted that the only previously known Tertiary American bufos possess the high steep type of prominence. The degree of curvature and the extent of the dorsal crest, if present (usually associated with a certain amount of lateral compression), differs somewhat from one species to another in living species of *Bufo*. In this fossil form the degree of curvature and the amount of lateral compression are slight, but are not beyond the range of variation found in the living forms.

The possession of an ilial prominence of this sort, not continuous with the ilial crest when such a crest is present, appears to be an almost unique characteristic of *Bufo*. The hylid ilium is somewhat similar, but with a more knob-like prominence, which tends to project more laterally, less dorsally. The entire bone in all hylids seen is of much more slender proportions. The typical leptodactylid ilium possesses a dorsal crest which is usually especially high in the acetabular region, but this expansion is very definitely a part of the crest itself, not a separate structure as in *Bufo*. Interestingly enough, the ilium of *Eupemphix* (*Engystomops*) resembles that of *Bufo* more closely than it does that of any other leptodactylid seen; this is a toothless form possessed of a number of other features reminiscent of *Bufo*.

The leg bones are of little diagnostic value on the specific level, other than to indicate that this form had relatively short and heavy limbs. The crests on the humerus are somewhat less prominent than in many species. The two openings of the foramen nutritium in the tibio-fibula are widely separated, the anterior being some distance distal to the posterior, with the latter situated on a rather prominent boss-like elevation. A somewhat similar condition, though less marked, occurs in some leptodactylids, but in hylids the two openings tend to be very nearly opposite.

In *Bufo* the surfaces by which the cervical vertebra articulates with the occipital condyles are rather closely, usually very closely, approximated ventrally, separated by a narrow notch, as in the single cervical vertebra in the present collection. In all hylids and most leptodactylids seen, these surfaces are very widely separated. The other presacral vertebrae in the collection are perhaps somewhat heavier than is typical of most modern species. The crest of the urostyle was probably rather low and not very extensive, as compared to most modern species, but the specimens are too fragmentary for me to be certain of this.

The general impression, from all elements considered, is that this was a short-limbed "squatty" toad, probably of around fifty millimeters snout-vent length.

OTHER REMAINS.—As mentioned previously, there are a number of specimens in the collection which cannot be definitely referred to *B. praeivius*, nor can it be certain that they do not belong to this form. In addition to these, there are others which, although I do not believe they can be actually identi-

fied with certainty, are obviously not referable to this species, and in most cases clearly do not belong to the genus *Bufo*.

One ilium (No. 1993) is very similar to those of *B. praeivius* except for the presence of a slight, but definite, projection on the anteroventral edge of the acetabular expansion. It is possible that this is simply an aberrant specimen of this species, but more probably it represents a different species of the genus *Bufo*.

One ilium (No. 1994), of which only a small part of the distal portion is present, is strongly suggestive of the genus *Rana*; two humeri (No. 2003) also strongly resemble these same elements in modern *Rana*, as do two portions of tibiofibulae (No. 2001). In addition to these specimens, which were all a part of the original collection examined by me, one ilium, more nearly complete than the above, is in my opinion definitely referable to the genus *Rana*. This latter specimen was recovered from the Thomas Farm matrix by Dr. E. E. Williams of the Museum of Comparative Zoology after this manuscript was first submitted for publication, and is as yet uncatalogued. In view of the incomplete nature of these remains, and the consequent impossibility of defining the species with any degree of exactness, I prefer for the present to forego formal description of this form. It is possible that not all of these specimens belong to the same form, or even closely related forms. The limb bones might conceivably be of leptodactylid origin, but their strong resemblance to *Rana*, along with the strong evidence of the presence of that genus afforded by the uncatalogued ilium, makes a reference to "*Rana* sp." the more reasonable interpretation. That these specimens, particularly the ilia, may represent members of any family other than the Ranidae or Leptodactylidae is very unlikely.

GENERAL REMARKS.—A number of papers have appeared on the Thomas Farm mammalian fossils: the mammalian fauna is summarized and discussed by Romer (1948); Wetmore (1943) has published on certain birds from this deposit; White (1942) has described an alligator; and Vanzolini has in press a study of the snakes and lizards. The only known amphibian remains are those dealt with in the present paper.

The exact position of these fossiliferous deposits in the Miocene time-scale is not completely settled. They have frequently been considered a part of the Hawthorne formation, of Middle Miocene age. Romer, however, believes that the mammalian fauna is definitely to be correlated with the Arikareean of the Great Plains. Such a correlation would require a Lower Miocene interpretation for these deposits, presumably corresponding with the Tampan of the Florida region. White (1942a) also appears to favor a Lower Miocene interpretation. He further postulates that the area concerned was an island, separated from the mainland by a distance of about 150 miles, from the close of the Oligocene until the Middle Miocene. If this postulation is correct, then it is very possible that the genera found on the island reached it before the end of the Oligocene, rather than during the Miocene itself. This insular interpretation has been questioned by some.

Fossils which have been referred to the genus *Bufo* are already known from the Oligocene of Europe; in this hemisphere the genus is known from the Pleistocene (Camp, 1917), the Upper Pliocene (Taylor, 1942) and the

Middle Pliocene (Taylor, 1936). Its earlier presence in North America has been presumed probable on distributional grounds; Schaeffer (1949) mentions the probability that it entered the Neotropical region from the Nearctic before the Middle Pliocene. The occurrence of the genus in these Florida deposits demonstrates conclusively that it had spread pretty well throughout the Nearctic by the Middle Miocene and perhaps, if the insular interpretation for this area should prove correct, as far back as the end of the Oligocene.

If the specimens referred to *Rana* sp. are correctly identified—and there can be little doubt as to the correctness of this interpretation of the uncatalogued ilium—this represents the earliest recorded occurrence of the genus, previously reported from no earlier than the Upper Miocene of Europe. It has been reported in North America only from the Upper Pliocene (Taylor, 1942), but much earlier occurrence would not be particularly surprising in view of the present distribution of the genus. It must have spread over most of the Old World during the early Tertiary, and may well have reached the New World at an equally early date.

Romer (1948) has stated that the mammalian fauna of the Thomas Farm indicates that this area was a low, warm, grassy plain at the time of deposition of the fossiliferous sediments. This inference is in no way negated by the known amphibian fauna, and may be considered to be supported if any credence dare be given to negative evidence. At the present time, *Bufo* is about as abundant in plains areas as in wooded areas, and *Rana* is found around the streams and ponds of both types of habitat. In warm forested regions one would expect to find large numbers of hylids, and perhaps of leptodactylids; there is no definite evidence of either in the Thomas Farm fauna.

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HARPER, KANSAS.

Temperature Data on the Terrestrial Hibernation of the Greenfrog, *Rana clamitans*

KURT K. BOHNSACK

HIBERNATION of the greenfrog in water has been reported by several authors—Wright (1947: 450), Pope (1947: 125), Walker (1946: 75), Morgan (1939: 359), and Dickerson (1913: 203)—but none cites instances of terrestrial hibernation. On January 14, 1950, I found and began observations on a hibernating greenfrog, *Rana clamitans*, in an oak-hickory woods in the Edwin S. George Reserve, Pinckney, Michigan. This reserve is a natural area maintained for biological studies and administered by the Museum of Zoology of the University of Michigan.

The nearest source of water from which the frog might have come is a temporary woodland pond, 60 × 150 feet, one hundred feet away. On August 19, 1949, and again by September 5, 1950, this pond was dry. A much larger permanent pond is located 380 feet downslope from the hibernating site.

The hibernating frog, which was underneath 2 inches of compact litter, fitted snugly into a soil pocket 2½ inches long, 2 inches wide and 1½ inches deep; soil never covered the frog throughout the period of observation (Jan. 14–April 11). That the frog was not completely inactive was shown by the fact that it lowered its eyelid when discovered. The temperature underneath the litter at that time was 36° F.

A 5-foot, flexible-tube, liquid, dial thermometer was used to record temperatures underneath the litter adjacent to the frog. These data are referred to as instantaneous temperatures (Table I). The temperature readings were taken weekly, between 3 and 4 PM, except for the period from February 25 through March 18 when they were given up in order not to disturb the deep snow cover which was then on the ground. In addition to the temperature data, the depth of the soil frost was determined within a 10-foot radius of the frog during the weekly visits to the area. Also, the soil moisture at a 3-inch depth in the vicinity of the frog was ascertained every week by the electrical resistance method (Bouyoucos and Mick, 1940).

Physical factors influencing soil frost in woodlands are so varied that ascribing soil frost beside the frog from measurements only one foot removed is supposition; however, it is important to know that there was a freezing of the soil beneath the litter, since Post and Dreibelbis (1943: 104) found soil frost in woodlands near Coshocton, Ohio to be only superficial, never going below ½ inch. I found freezes as deep as 3 inches into the soil underneath the litter. On January 22 the soil next to the frog was frozen to a 1½-inch depth.

At no time did the thermometer register below freezing next to the frog. Once the temperature was 32°, and another time (January 22) ice crystals were present in the soil beside the hibernating animal. The frog niche was not examined thoroughly every week so that there may have been soil frost there at other times.

Periodic temperature measurements naturally do not reflect the microclimate tolerated by the frog. However, temperature data were available from a permanent weather station, located in a similar habitat, 350 feet from the frog's niche. Pertinent data taken approximately at weekly intervals from four maximum-minimum Taylor Six's self-registering thermometers placed, respectively, $4\frac{1}{2}$ feet above the ground, on the surface of the litter, underneath the litter, and $2\frac{1}{2}$ inches into the soil, are submitted for comparison (Table I).

TABLE I

TEMPERATURES IN FROG NICHE, BENEATH LITTER, IN SOIL, ON SURFACE OF LITTER, AND $4\frac{1}{2}$ FEET ABOVE GROUND; ALSO, DEPTH OF SOIL FROST AND PRESENCE OR ABSENCE OF SNOW COVER

Instantaneous temperatures (Inst.) are temperatures occurring at time of recording; maximum (Max.) and minimum (Min.) temperatures are for the intervals between observations, those on January 14 are for the interval from January 7 to 14.

Date	Frog Niche, Inst.	Underneath the litter			Soil ($2\frac{1}{2}$ inches)		
		Inst.	Min.	Max.	Inst.	Min.	Max.
January 14	36	31	27	53	35	33	41
January 22	34	33	22	38	32	30	35
January 28	35	33	25	57	32	32	42
February 4	32	32	26	39	32	32	33
February 11	35	36	28	36	32	31	32
February 18	35	33	26	36	33	32	33
February 25	—	30	29	33	32	32	33
March 4	—	32	30	32	31	31	32
March 11	—	32	17	39	32	27	32
March 18	—	32	27	33	31	31	32
March 25	36	42	26	45	32	29	32
April 1	36	33	29	49	32	32	33
April 11	36	36	29	60	38	32	44

TABLE I (CONCLUDED)

Date	Air ($4\frac{1}{2}$ feet)			Surface of litter			Inches soil frost	Snow cover
	Inst.	Min.	Max.	Inst.	Min.	Max.		
January 14	25	5	60	31	14	58	None	None
January 22	36	0	46	33	9	40	1-2	Snow
January 28	37	9	67	38	15	62	$\frac{1}{2}$ -1 $\frac{1}{2}$	None
February 4	34	9	43	34	17	41	0-2 $\frac{1}{2}$	Snow
February 11	40	19	40	38	22	39	$\frac{1}{2}$ -1	Snow
February 18	36	19	41	33	24	38	None	4"
February 25	18	-4	37	29	23	33	None	14"
March 4	40	2	40	31	26	32	1	Snow
March 11	36	12	52	33	16	39	0-3	Snow
March 18	26	10	37	32	24	33	$\frac{1}{2}$ -3	Snow
March 25	44	8	47	44	22	46	0-2 $\frac{1}{2}$	None
April 1	33	19	56	33	21	53	None	None
April 11	36	18	68	37	22	71	None	None

Despite the spatial difference between these thermometers and the hibernating site, I feel that the readings from them afford an understanding of the minimum temperatures very likely experienced by the frog, since on six

occasions the temperatures at the frog's niche differed from those beneath the litter at the weather station by only 0 to 2 degrees. Further, I found over a 2-year winter period that the minimum temperatures recorded in the woods by two thermometers, 200 feet apart and at a soil depth of $2\frac{1}{2}$ inches, never differed from one another by more than 2 degrees, and were usually identical. The frog was in a soil pocket $1\frac{1}{2}$ inches deep, and not covered by soil; therefore, the soil temperatures at the $2\frac{1}{2}$ -inch depth at the weather station would be higher, on the average, than the temperatures next to the frog—because of the $2\frac{1}{2}$ -inch soil insulation present in the first instance, as compared to an absence of soil over the frog. At least it would not be unreasonable to assume that the temperatures in the hibernating cavity certainly went as low as those measured at the $2\frac{1}{2}$ -inch soil level. During six recorded periods the soil temperature at this level was below 32° .

A maximum-minimum thermometer at the weather station was underneath one inch of litter, and additionally insulated by a $\frac{1}{2}$ -inch board to which it was fastened. This was probably not so much insulation as the 2 inches of litter covering the frog, but approximated it. The minimum temperatures under the litter at the weather station were consistently below freezing, once as low as 17° (March 11). Therefore, considering the data from the weather station and understanding the possibility of error in transference of such data to another site, although in this case I believe that there is justification for doing so, with caution, it is very probable that the frog often tolerated temperatures below 32° . Although the temperatures next to the frog may not have been so low as those recorded underneath the litter, they certainly were as low as, if not lower than, the readings found at the $2\frac{1}{2}$ -inch soil level at the weather station.

During the 13-week period, the temperatures of the soil at a depth of $2\frac{1}{2}$ inches varied only 17 degrees, in contrast to a variation of 43 degrees underneath the litter, and of 62 degrees on the surface of the litter. This shows the relative extent of insulation by soil and litter, and how this insulation minimizes temperature fluctuations.

The soil alongside the frog was moist throughout the winter, varying between 72 and 78 percent in available moisture. Undoubtedly this high moisture content of the soil prevented a premature termination of hibernation, because of the high specific heat and low thermal conductivity of water. Likewise, a moist environment would retard rapid temperature changes during the period of hibernation.

There is no doubt that litter, soil and snow were good insulators; nevertheless, freezing, and very likely sub-freezing, temperatures occurred in the hibernating site during the winter of 1949-50.

The above study was made incidental to another problem during my tenure of the Edwin S. George Reserve Fellowship. For their helpful suggestions, I give my sincere thanks to Dr. Norman Hartweg and Mr. Bernard S. Martof.

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DEPARTMENT OF ZOOLOGY, SWARTHMORE COLLEGE, SWARTHMORE, PENNSYLVANIA.

Herpetological Notes

NOTE ON THE HERPETOLOGY OF THE ELK MOUNTAINS, COLORADO.—Cold-blooded vertebrates of high altitudes face the problems of reproduction and nutrition in the limited period of time during which conditions are suitable. Amphibians have the additional problem of completing the larval period. A small amount of pertinent data bearing on this general problem is here presented.

The writer spent the period July 2 to August 12, 1950, at the Rocky Mountain Biological Laboratory located in the Elk Mountains at the ghost town of Gothic, some 8 miles northeast of Crested Butte, Colorado. The laboratory is located in a glacial valley just above the junction of Copper Creek with East River. Both of these streams are largely snow-fed. East River rises in Emerald Lake, a small glacial lake some 5 miles up the valley from the laboratory. Just below Emerald Lake are two smaller glacial lakes, locally called Axolotl Lake and Lizard Lake. Along the sides and floor of the valley of East River beaver ponds are extremely plentiful. About a mile below

the laboratory and located on a morainal deposit is a cluster of some half dozen small, shallow glacial ponds. The altitude at the glacial ponds and the laboratory is approximately 9,500 feet, and at Emerald Lake, 10,000 feet; surrounding peaks rise above 12,000 feet. Regular nightly frosts begin early in August at the laboratory.

The greatest abundance of reptilian and amphibian life was observed in the shallow glacial ponds where standing water was warmed by the sun; the spring- and brook-fed beaver ponds, with much colder water, supported less life. The glacial lakes seemed to be without anura. No amphibians were found in East River or Copper Creek nor, despite diligent search under fallen logs, in the wet spruce-fir forest. No reptilian or amphibian life was found above approximately 10,000 feet altitude. Judging from larvae found, the local anurans bred probably in late May and June; no breeding amphibians were found.

The only reptile present, the gartersnake (*Thamnophis ordinoides vagrans*), was very common in the small glacial ponds, each one supporting a population of a half dozen or more snakes. Along streams and in beaver ponds snakes were occasionally seen, and they were often observed as much as 200 yards from water. The highest altitude at which a snake was seen was approximately 10,000 feet, at Axolotl Lake. A snake of some 38 cm. body length was observed with a 65-mm. larva of *Ambystoma tigrinum nebulosum* crosswise in its mouth; some 10 minutes later the snake had completed the swallowing process. On another occasion a *Microtus* was seen to dash from a clump of sedges in a dried-up glacial pond, and investigation of the immediate area revealed a large gartersnake. The snakes were quite docile and made no effort to bite when picked up.

Leopard frogs, *Rana pipiens*, were found only in the glacial ponds. Mature tadpoles were seen on July 24 and August 3, but no metamorphosing animals were observed. Adults were common in one of the ponds which had recently dried up but was still boggy. The vegetation of this bog supported an abundance and variety of insect life suitable for anuran food.

Bufo boreas was common about glacial ponds, beaver ponds, and marshy areas. None was observed above 10,000 feet. Metamorphosing tadpoles were observed on August 2 and August 9 at an elevation of 10,000 feet. Mature tadpoles had a total length of 30 to 36 mm. At one beaver pond the toads emerging from the water had a body length of 10 to 12 mm. (August 9), while at another beaver pond the toads at a comparable stage of development had a body length of 15 to 16 mm. (August 2). The newly metamorphosed toads, and even the 4-legged tadpoles, were extremely warty. A 27-mm. toad was taken on August 2, and two (approx. 35 mm.) specimens were collected on July 25; whether these are 1950 animals is not apparent.

Pseudacris nigrita triseriata was found up to 10,000 feet. Tadpoles were common in the beaver ponds around Axolotl Lake and in the glacial ponds. Mature tadpoles had a total length of 35 to 38 mm. At one beaver pond frogs were metamorphosing (August 9) at a body length of 7 to 8 mm., while at a glacial pond they were metamorphosing (July 22) at a body length of 10 to 12 mm. The morning of July 25 an adult female (33 mm. body length) and two adult males (33 and 27 mm. body lengths) were caught only a few inches from one another in the water in a beaver run near Axolotl Lake; three smaller specimens, the smallest 19 mm. in body length, were taken jumping about near water.

Ambystoma tigrinum nebulosum was common in the area in glacial lakes, glacial ponds, and beaver ponds. However, none was seen in Emerald Lake. Dr. John C. Johnson, who has long been familiar with the area, said that the tiger salamander was common in Emerald Lake 25 years ago, and that he believed that the introduction of trout was responsible for its disappearance. However, both trout and salamanders are present in Axolotl Lake. The tiger salamander was not observed above approximately 10,000 feet, and all were larvae except three adult males (210, 198, and 193 mm.) taken in one of the glacial ponds July 24 and August 3. The larvae in the glacial ponds showed a size range from 40 to 130 mm. on August 3. Immature gonads were found in ten larvae of approximately 130 mm. total length from Axolotl Lake. I saw no evidence of neoteny in the tiger salamander of this area.—ALBERT P. BLAIR, *Department of Zoology, University of Tulsa, Tulsa 4, Oklahoma.*

A CASE OF LIMB REGENERATION IN THE CHILEAN IGUANID *LIOLAE-MUS*.—Among more than 2000 specimens of lizards of the South American genus *Liolaemus* that have passed through my hands in the course of systematic studies, only one presents the phenomenon of limb regeneration, though there is an extraordinary proportion of specimens with regenerated tails. The specimen in question represents the subspecies *Liolaemus altissimus altissimus* Müller and Hellmich, which inhabits the high cordillera of Santiago de Chile. It was collected by Mr. W. Schroeder at Potrero Grande, at 2200 meters, on February 26, 1933 (Zool. Staatssamml. München No. 214/1947). The regenerated limb came to my attention in the course of preparation of my report on the Schroeder collection (Hellmich, 1950, Veröff. Zool. Staatssamml. München, 1: 129-194, pls. 11-12).

The rarity of regenerated limbs in lizards is remarkable in view of the capacity for tail regeneration that is so widespread in the group. Marcucci (1930, Arch. Zool. Ital., 14: 227-52, pls. 10-13; 1931, *Ibid.*, 16: 455-58) has summarized the known cases together with his own investigations of experimental production of regeneration of limbs. Limb regeneration has been observed in members of the family Lacertidae (*Lacerta agilis*, *L. muralis*, *L. viridis*, *L. vivipara*) and in the Scincidae (*Chalcides ocellatus*). The case here reported adds a representative of the Iguanidae to this series (Fig. 1).

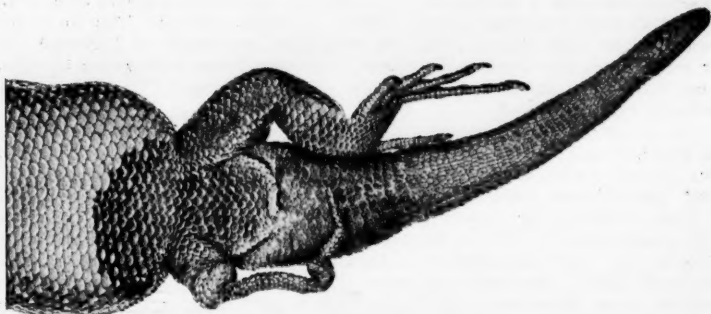


Fig. 1. Limb regeneration in *Liolaemus a. altissimus*.

The right hind limb of the specimen was evidently bitten off in the course of fighting (frequent among lizards of this species) or by a predator. In addition to three small regenerative tubercles, a regenerative elongate tail-like structure projects from the center of the stump. The innermost bud, visible only from above, forms a short stump with a few scales, the outermost of which have somewhat the form of a nail, without being otherwise nail-like. The elongate, middle regenerative structure is also covered with scales, some rhomboidal, others oval-pointed, and all with sharp keels that may end in a long spine. The scales most resemble those of the normal tail in this species, but their irregularity recalls those of a regenerated tail; this comparison is facilitated in this specimen by the fact that the tail has been twice regenerated.

The regenerated limb is cylindrical, with a right-angled angulation at about the middle. Posterior to the angulation it is somewhat thickened, then bent twice downward, and then attenuate. At the extreme tip, the scales are unkeeled. At the point of origin, the regenerate is movable, as if an articulation were present; there seems, however, to be no bony supporting structure, as the regenerate can be bent at any point. The measurements of the regenerated limb and of the normal left one are as follows: length of head and body 74 mm.; of tail 51 mm. (regenerated); total length of left hind limb 44 mm., of thigh 13.5 mm., of foot 21 mm.; length of stump 6 mm., of straight portion of regenerate 11.5 mm., of angulate portion 11 mm.

The regenerated structure here described closely resembles those figured by Marcucci (1930). Some of those regenerates, which had been produced artificially by amputation,

likewise show sharp angulation. Also, the regenerative structures are provided with cartilaginous skeleton, sometimes with bony elements, and with muscles, though these do not insert on the bones and resemble tail muscles. There are also nerve fibers, and the regenerated limb structures exhibited a certain amount of movability. We may assume that the internal structure of the regenerate in the Chilean iguanid is like that of Marcucci's specimens. The capacity for regeneration of extremities in lizards thus seems to be not entirely lost, but no longer extends to the re-development of a complete and functional extremity.—WALTER G. HELLMICH, *Zoologische Staatssammlung München, Menzingerstrasse 67, Munich 38, Germany.*

DISTRIBUTION AND VARIATION OF THE BLACK-HEADED SNAKE IN NEBRASKA.—The failure of most authors to include southwestern Nebraska in the range given for *Tantilla nigriceps nigriceps* Kennicott has prompted us to summarize data on the eight known specimens from the state. *Tantilla* was first reported from Nebraska by Ralph Dury (1932, Proc. Jr. Soc. Nat. Sci. Cincinnati, 3: 26-28) who incorrectly identified a specimen of *T. n. nigriceps* (now Univ. Nebraska State Mus., No. 1291) from Sutherland, Lincoln County, as *Tantilla planiceps*. This report was overlooked by G. E. Hudson (1942, The Amphibians and Reptiles of Nebraska), but he reported two other specimens, one from Cambridge, Furnas County, and the other from Bartley, Red Willow County. No other published reports of *T. n. nigriceps* from Nebraska have been found.

In addition to the specimens listed above, five others have recently been collected in Dundy, Frontier, and Hitchcock counties. A black-headed snake (UNSM No. 1783) was collected 9 miles south and 6 miles east of Stockville, Frontier County, in May, 1947. This snake was discovered 8 inches below the surface of the soil on top of a bluff. A single specimen (Univ. Kansas Mus. Nat. Hist., No. 28101) was obtained from the high school grounds in Stratton, Hitchcock County, in the spring of 1947, and another (UNSM No. 1836) was found in a basement on December 1, 1950, at Trenton, Hitchcock County. Two additional specimens (UKMNH Nos. 28102 and 28103) were collected by the junior author and Olin L. Webb, 5 and 6 miles east of Haigler, Dundy County, July 28, 1948. These snakes were found crawling on a black-top road (U. S. Highway No. 6) following a light shower shortly after dark.

The coloration of the eight individuals is light above and below, with a black cap on the head. The black cap is broadly convex or pointed (V-shaped) posteriorly, extending back onto the third or fourth scale from the parietal suture. Laterally the black extends down onto the upper edges of the second, third, fourth, fifth, and seventh upper labials, covering the upper half of the first temporal and the entire second temporal.

Scale characters of the specimens are as follows: 7 upper and 6 lower labials; 1 preocular; 2 postoculars; 2 temporals, first in contact with postoculars; mental separated from chinshields; prefrontal separated from labials in six specimens, not separated in two; ventrals, males (3) 143-153, females (4) 156-163; caudals, males (2) 52, females (2) 38 and 42. Total lengths (4) 200-268 mm., body (7) 158-237 mm., tail (4) 42-48 mm.

The average count of 159 ventrals for the four females is more than the average of 155 listed for this subspecies by F. N. Blanchard (1938, Field Mus. Nat. Hist. Zool. Ser., 80: 369-76). The previous maximum number of 161 ventrals is also surpassed by a female with 163.

On the basis of present information, *Tantilla n. nigriceps* Kennicott extends northward into southwestern Nebraska, at least to the Platte River Valley. All except one of the Nebraskan localities are in the western part of the Republican River drainage system.—RICHARD B. LOOMIS, *Museum of Natural History, University of Kansas, Lawrence, Kansas*, and J. KNOX JONES, JR., *Nebraska Game and Parks Commission, Lincoln, Nebraska*.

PATTERN NEOTENY IN THE SALAMANDER *EURYCEA LUCIFUGA* RA-FINESQUE.—In a series of specimens of *Eurycea lucifuga* collected by the senior author and Richard B. Loomis in a cave two miles north of Flint, Delaware County, Oklahoma, on March 4, 1950, one was found outstanding by its departure from the normal pigmentation of this species.

The specimen (Univ. Illinois Mus. Nat. Hist., No. 12195), a male, agrees very closely with Dunn's (1926, *Salamanders of the Family Plethodontidae*; 339) description of a typical male of the species and with normal individuals of the same population. The outstanding peculiarity involves the grouping of the melanophores, which in normal individuals form well-defined black dorsal spots (Fig. 1).

In the atypical specimen, posterior to the insertion of the hind limbs, the pigmentation does present an almost typical appearance. From the hind limbs to the snout the melanophores, as seen with the naked eye, form large, more or less intercon-

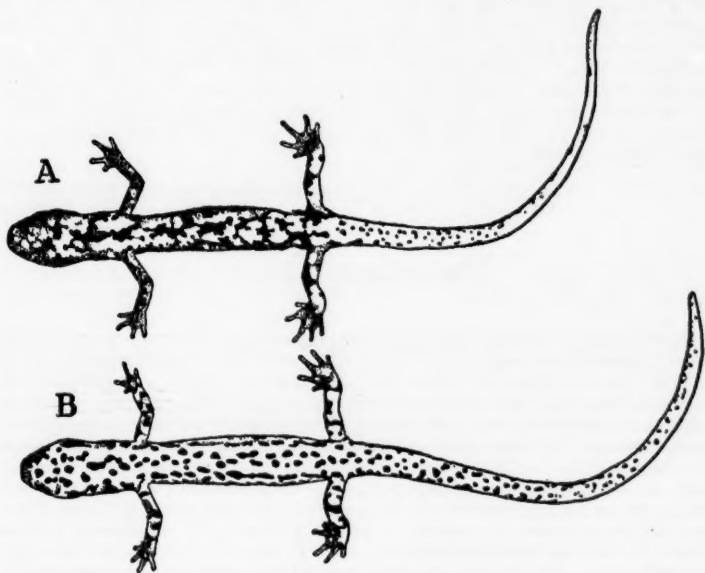


Fig. 1. *Eurycea lucifuga*: A, UIMNH No. 12195; B, UIMNH No. 12192.

nected blotches, none seeming to be completely isolated. Examination with a lens and comparison with a typical specimen of the same series (UIMNH No. 12192) reveals that the individual melanophores are much more widely spaced, enclosing relatively large light areas. This condition extends onto the limbs and toes of the animal, and the tail which superficially appears normal also exhibits the phenomenon of the widely spaced melanophores.

Two other somewhat similar specimens of this species from Rockhouse and Marble caves in Missouri have been reported by Eigenmann and Kennedy (1903, *Biol. Bull.*, 4: 227-228, Fig. 1). These differ from the present specimen in possessing small, very dark spots in the middle of the back similar to those of the adult, whereas the diffuse spots are more restricted to the lateral surfaces. The authors describe melanophore concentration on the margins of, or within the blotches, and regard them as centers of distribution. In all probability they are actually centers of aggregation as indicated by

Banta and McAtee (1906, Proc. U. S. Nat. Mus., 20: 79). These centers are not present in the Oklahoma specimens.

Furthermore, as suggested by Banta and McAtee (1906), it is probable that these aberrant patterns represent different stages in arrested transformation of pattern from the typical, wholly diffuse larval type to that of the adult. The different stage exhibited by the Oklahoma individual, when added to the stages of the Missouri specimens, strengthens the theory of neoteny in pattern development.

These individuals are the only ones of the species reported to exhibit neoteny in any form. They add to the growing mass of evidence that the Ozark uplift and its environs to the south and west are marked by an extraordinarily high frequency in occurrence of neoteny. This contrasts sharply with the Appalachian region where occurs no endemism whatsoever of neotenic variants of any category, despite an even greater abundance of salamander species. Several wholly neotenic plethodontids are known from the western area, none from the eastern United States. Furthermore, if any differences between east and west are observable in such neotenic genera as *Cryptobranchus*, the more juvenile characters tend to occur in the west. We do not imply that neoteny does not occur in the eastern United States; it is known there but not elsewhere in such widely distributed species as *Diemictylus viridescens* and in *Pseudobranchius*. Nevertheless, the much greater frequency of occurrence of the condition in the west is obvious.—ROBERT W. REESE, Department of Zoology, University of Kansas, Lawrence, Kansas and HOBART M. SMITH, Museum of Natural History, University of Illinois, Urbana, Illinois.

Ichthyological Notes

A NOMENCLATORIAL CORRECTION FOR "A REVISION OF THE AMERICAN CLINGFISHES, FAMILY GOBIESOCIDAE, WITH DESCRIPTIONS OF NEW GENERA AND FORMS."—I published a revision of the American clingfishes (1944, Proc. U. S. Nat. Mus., 96: 47-77) and unfortunately selected *Sicyases rubiginosus* Poey as the type species for the new genus *Acyrtus*. On a recent trip to the Museum of Comparative Zoology, Cambridge, Massachusetts, I examined the types of *Sicyases rubiginosus* Poey, 1868 and of *Sicyases carneus* Poey, 1868. To my surprise these represent a species entirely different from my interpretation as based on Poey's original description. Both species are the same and are synonyms of *Arcos macrophthalmus* (Günther, 1861). Since this discovery makes it necessary to transfer *Acyrtus* to the genus *Arcos*, it leaves that phyletic line of gobiesocid fishes without a generic name. To overcome this deficiency, I herewith propose the new genus *Acyrtops* with *Gobiesox (Rimicola) beryllinus* Hildebrand and Ginsburg as the type species. This new genus has the same definition and description as given in my paper (1944: 49, 51) for *Acyrtus*. The genus *Acyrtops* is monotypic so far as known, and the specimens listed on page 56 under the heading "Material examined," must now bear the name *Acyrtops beryllinus* (Hildebrand and Ginsburg).

To the synonymy of *Arcos macrophthalmus* (Günther) listed on page 72 must be added the references to the species as listed on page 56 as follows: *Sicyases rubiginosus* Poey, *Sicyases carneus* Poey, *Gobiesox rubiginosus* (Poey) and *Gobiesox carneus* (Poey).—LEONARD P. SCHULTZ, U. S. National Museum, Washington 25, D. C.

CORRECTION FOR "A REVISION OF NORTH AMERICAN SHARKS ALLIED TO THE GENUS *CARCHARHINUS*."—In a recent publication (1950, Amer. Mus. Novitates, 1451: 1-13) I proposed the name *Pterolamia* for a genus of sharks. That this is preoccupied by *Pterolamia* Breuning (Folia Zool. Hydrobiol., Riga, 1942, p. 128) for a genus of beetles was brought to my attention by Mr. Gilbert P. Whitley. I therefore propose a new generic name, *Pterolamiops*, to replace *Pterolamia* Springer and designate the same genotype, *Squalus longimanus* Poey, 1861.—STEWART SPRINGER, U. S. Fish and Wildlife Service, Pascagoula, Mississippi.

THREE RARE FISHES (*NODOGYMNUS*, *PAREQUES*, AND *CANTH-IDERMIS*) FROM THE FLORIDA EAST COAST.¹—This note deals with three rare fishes which have appeared in material collected in the St. Augustine region for exhibit at Marine Studios, Marineland, Florida.

On October 24, 1949, a living naked sole was taken by trawling on a sandy bottom at six fathoms two miles due east of Matanzas Pass. It was exhibited for three days and behaved much in the manner that characterizes captive hogchokers, *Trinectes maculatus fasciatus* (Lacépède) and striped soles, *Achirus lineatus* (Linnaeus), burying itself in the sand at the bottom of the aquarium. When disturbed, the vertical barring which prompted the writer to dub it a "zebra sole" (vernacular names being important in public aquarium work) became very prominent. The fish is identified as *Nodogymnus fasciatus* (Günther). In most respects it agrees with the descriptions of that species as published by Günther (1862, Cat. Fish. Brit. Mus., 4: 488-9) and Kendall (1911, Proc. U. S. Nat. Mus., 40: 201-03). This identification must be considered tentative, however, because in some respects the fish more closely resembles *N. williamsoni* Gunter (1936, COPEIA, (3): 203-09) than *N. fasciatus*. The description of this specimen follows:

Dorsal about 68; anal 47; caudal 16; pelves 5 each. Total length 12.75 cm.; standard length 10.4 cm. Depth (without fins) in standard length 1.7; head in standard length 4.8; eye in head 4.2; eye in pectoral 1.1; depth of caudal peduncle in head 2.0. A pectoral fin of two rays, the lower longer than the eye, is found on the eyed (right) side. There is no left pectoral. The eyes are joined and partly covered by a common membrane. The lower eye is displaced slightly anterior to the upper. The urinary papilla is above the insertion of the second anal ray on the eyed side, and is lower than the anus which is on the left side above the first anal ray. The mouth is turned down posteriorly on both sides. In these respects the specimen resembles *N. fasciatus*. The color of the fresh specimen agreed very closely with Gunter's description of *N. williamsoni*. In spirit it has faded somewhat, but the pattern has not changed. The lateral-line system on the eyed side is identical with that shown in Gunter's sketch of *N. williamsoni*. The positions of the nasal tubes are also in agreement with that species. A reticulated pattern of sensory hairs such as Gunter reported for *N. williamsoni*, and which may have been overlooked by Kendall in his description of *N. fasciatus*, is found on the blind side of this specimen. The preserved sole has been deposited in the American Museum of Natural History and is catalogued as AMNH No. 18889.

On November 28, 1949, two living sciaenids, differing from any which the writer had hitherto seen, were collected by trawling from a rocky (old coral) bottom at ten fathoms about twelve miles east of St. Augustine. One of these died early in January, 1950, and was sent to the American Museum, where it was catalogued as AMNH No. 18890. The other thrived in captivity at least until mid-April, 1950. A sketch of the preserved specimen, with the color pattern of the live fish superimposed, is shown in Figure 1. The preserved fish was tentatively referred to *Pareques acuminatus umbrosus* (Jordan and Eigenmann), as described by Jordan and Evermann (1898, U. S. Nat. Mus., Bull. 47: 1488). Mr. J. T. Nichols, to whom the writer is much indebted for guidance in preparing this report, concurred in this identification. It is described as follows:

Dorsal X-42; anal II, 7. Scales 66. Standard length 15.7 cm.; Depth in standard length 2.7; head in standard length 3.5. Eye, and snout, in head 3.7; maxillary (from tip of snout) 2.5, reaching to under middle of eye; interorbital 4.3; width of body 2; depth of peduncle 3.5; longest dorsal spine (equal to longest ray) 2.5; second anal spine (equal to longest ray) 2.3; pectoral 1.4; pelvic 1.3; caudal 1.4. The profile is steeper than that of *P. a. acuminatus* (Bloch and Schneider), slanting up from the end of the narrower, more pointed snout in an approximately straight line to the top of the head, then on up in a gentle curve to the origin of the dorsal. The spinous dorsal is less high than that of *P. a. acuminatus*. The scales on the top of the head to the mid-line of the eye are markedly ctenoid (as are those on the cheeks). From this point forward onto the snout, the scales are more abruptly reduced in size than in *P. a. acuminatus*. Those on the cheeks are described as cycloid in the specimen referred to as *P. a. umbrosus* from Pensacola, Florida, by Jordan and Evermann.

¹ Contribution from the Duke University Marine Laboratory, Series A, No. 51.

In preservation, the head, inside of the gill cavity, and spinous dorsal are blackish. The other fins are dusky. The sides are dull grayish, crossed by thirteen somewhat indistinct, narrow, dark, lengthwise streaks, which fade out more or less posteriorly, the uppermost following the curve of the back, the others approximately horizontal and parallel.

In the living fish, the ground color is dull buff with a bright coppery iridescence on the scales. This sheen is particularly noticeable on the operculum, where it has a rosy cast. In direct light, the snout and mouth have this coppery gleam, but in reflected light, a hoariness, probably due to thick skin, is characteristic. This makes the mouth seem white to the casual observer. The iris is coppery. The fins are of a pale dusty color, without apparent glint. The soft dorsal has two lengthwise, faint shadowy bands.

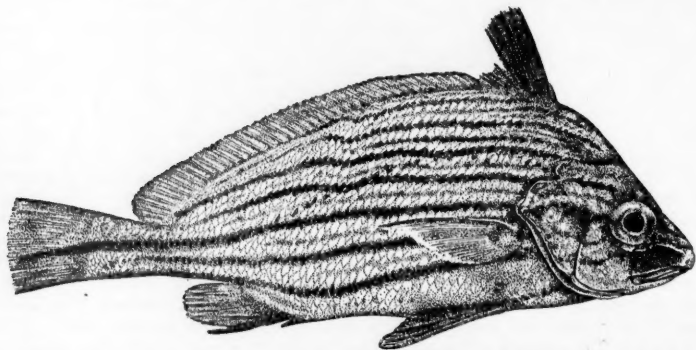


Fig. 1. *Pareques acuminatus umbrosus* (Jordan and Eigenmann), from a specimen 15.7 cm. in standard length.

The body has seven brown, lengthwise bands about a half-scale in width. The fifth band, counting downward from the base of the dorsal, extends to the margin of the caudal fin. The fourth, sixth, and seventh bands extend onto the peduncle, but do not invade the caudal fin. Between these seven are six thinner, fainter bands. The coppery iridescence of the scales gives the bands a reddish tone.

The writer has seen a great many living specimens of *P. a. acuminatus*, ranging from two to seven inches in length. It is felt that if the specimens dealt with here were identifiable with that subspecies, the fact would have been immediately recognized. Small *P. a. acuminatus* are strikingly white, with seven narrow and very dark lengthwise bands. Four of these bands are more prominent. One follows the line of the back, a second extends from the shoulder to the posterior insertion of the dorsal, the third is on the mid-line of the body, and the fourth runs from below the pectoral to above the posterior insertion of the anal. The remaining three weaker bands lie between these four. As the typical subspecies grows, these seven bands increase in width, especially the three intermediate ones, resulting in a dark fish with pale lengthwise bands. The contrast between light and dark bands in large *P. a. acuminatus* is greatly increased when the fish is disturbed. At no time may one see in *P. a. umbrosus* a comparable contrast in color. When this fish is excited it becomes very dark, the bands becoming much less noticeable. The writer has never seen the coppery sheen in *P. a. acuminatus*.

The third unusual specimen was an ocean triggerfish, picked up in a beach slough at St. Augustine Beach on January 7, 1950. This fish, identified as *Canthidermis maculatus* (Bloch), is probably the first definite record for the species from Florida. As it is a pelagic species, its presence in a beach slough is probably attributable to a violent north-easter to which that region was subjected on December 25, 1949. It has been catalogued as AMNH No. 18891.—HENRY KRITZLER, *Duke University Marine Laboratory, Beaufort, North Carolina.*

THE CORRECT GENERIC AND FAMILY NAME OF THE DEEPEA HATCHETFISHES (*STERNOPTYX* AND *STERNOPTYCHIDAE*).—In preparing a selected bibliography on the Isospondyli *sensu lato*, for use by this Society's Committee on Fish Classification, I became aware of the considerable number of recent publications employing the misspelled generic name *Sternoptix* and family name Sternoptichidae. As most authors dealing with these groups have been careful workers, I sought the reason for repetition of this error.

When one realizes that Hermann's description of *Sternoptyx* (1781, Naturforscher, 16: 33) is very old and generally unavailable and that the investigator is therefore forced to turn to the nomenclators, it becomes apparent that the errors stem from the latter. On page 44 of Jordan's "The Genera of Fishes" (1917, Stanford Univ. Publ., Univ. Ser.) Hermann's generic name is incorrectly spelled (as is his own name), and in Jordan's "A Classification of Fishes" (1923, Stanford Univ. Publ., Univ. Ser., Biol. Sci., 3 (2): 127) the error is repeated with a footnote that states "Usually written *Sternoptyx*." However, in this latter publication Jordan correctly derived the family

8 Neues Fischgeschlecht,
II.
Herrn D. Johann Hermanns,
Professors der Medicin und Philosophie in Erlangburg,
Schreiben
an den Herausgeber
über
ein neues
amerikanisches Fischgeschlecht,
STERNOPTYX DIAPHANA,
der durchsichtige Brust- und Falten-Fisch.

Tab. I. Fig. 1. und 2.

Ich kenne, mein verehrtester Freund, in Ihrem
Vorbericht zum 14ten Stück des Naturfor-
schers, daß bisher noch gar keine Abhandlung zur Ge-
schichte der Fische in demselben vorkommt. Sie
haben ganz recht, und oft schon hab ich mich geäu-
sert, daß in unserm farbenreichen halben Jahrhun-
dert, wo so viele kostbare Werke die nämliche Pflanze,
den nämlichen Vogel, den nämlichen Schmetterling,
das nämliche Schneckenhäuse wiederholen, wo jeder
Künstler den andern übertrifft, und seinen Pinsel
und Grabstichel in Werken der Natur veremigen, und
auch, welches nicht selten der Fall ist, sein hässlich
Erd

Sternoptyx diaphana.

dem Salmo Aneostomus L. der Clupea Sims L. und auch
mit dem im übrigen ganz anders gebildeten Uranosco-
pus. Vielleicht möchten auch einige wegen der Falten
auf der Brust eine Vergleichung zwischen ihm und dem
Schmetterling (Cyclopterus) und den Leichterfischen
(Gobius) anstellen wollen. Doch genug hiervon.
Auf nachfolgende Weise durch seine Kennzeichen be-
stimmt, kann man dieses neue Geschlecht, nebst der
oben versprochenen kurzen Beschreibung in das lin-
näische Verzeichniß einrücken:

ORDO PISCUM APODUM.

STERNOPTYX. Caput obtusum. Os finum.*)

Dentes minutissimi.

Membr. branchiæ, nulla.

Corpus compressum, alepidod-
rum; sternum carinato, bi-
farium plicato; abdomine
pellucidum.

diaphana. 1. STERNOPTYX.

Habitat in America, sine dubio
Jamaica.

Descript. Corpus biunciale, compressum,
anice truncatum, pollice angulatum, alepidorum,
argenteum.

*) Ich habe dieses Endwort, ungeachtet es eigentlich
die Gestalt der Nase und nicht des Mundes ausdrückt,
beibehalten; weil es einmal angenommen ist, und ich
kein besseres weiß.

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Fig. 1. Pages 8 and 33 from Hermann. Photographed by W. L. Cristanelli.

name as Sternoptichidae. In their often used but ill-fated Check List (see Myers, 1935, COPEIA (4): 196, for the conditions surrounding the publication of this work), Jordan, Evermann and Clark (1930, Rept. U. S. Fish Comm., pt. 2 (1928): 73) misspelled the generic and family names of the hatchetfishes (and again Hermann's name) and cited *Sternoptyx* as "authors' amended spelling." The various other nomenclators (Agassiz, Scudder, Sherborn, Schulze with associates, and Neave) list the generic name correctly but except for Sherborn (1902, Index Animalium, sect. 1: 299) and Neave (1940,

Nomenclator Zoologicus 4: 307), all of the above works have cited the source or page of the original description incorrectly. In order to establish the correct citation and to prevent further copying of these misspellings in Jordan's papers, the title page and first page of the original description (page 33) of Hermann's genus is reproduced herewith (Fig. 1). As can be seen, the correct generic name for this fish is *Sternoptyx* and the family name derived from it becomes Sternoptychidae. Fortunately, these spellings are correct on classical grounds as well as on the basis of priority.—NORMAN J. WILIMOVSKY, *Natural History Museum, Stanford University, Stanford, California.*

A BLACKFIN TUNA (*PARATHUNNUS ATLANTICUS*) FROM NORTH CAROLINA WATERS.—During a cruise of the U. S. Fish and Wildlife Service research vessel ALBATROSS III off the coast of North Carolina in June, 1949,¹ a single specimen of blackfin tuna, *Parathunnus atlanticus* (Lesson), was collected. It was taken on a surface-trolled lure about 20 miles south-southeast of Cape Hatteras (34°56' N., 75°22' W.) in water of 50 fathoms. The fishing methods used on this cruise are recorded in a paper by Schuck (1951, COPEIA (1): 35-39) which described the dolphin taken at this time.

From criteria given in Beebe and Tee-Van (1936, Zoologica, 21: 180-84)—largely the gill-raker counts—we have identified the specimen as the blackfin tuna, rather than the yellowfin tuna, *Neothunnus argenteivittatus* (Cuvier), to which it bears a close external resemblance. Beebe and Tee-Van gave the range of gill-raker counts for *P. atlanticus* as 5 to 6 + 15 to 18 for 52 Bermuda specimens and 5 to 6 + 15 to 16 for 25 British West Indies specimens. Their counts for *N. argenteivittatus* were 10 and 11 + 21 for 1 Bermuda fish and 9 or 10 + 20 to 22 for 3 British West Indies specimens. Our specimen has 6 + 17 gill rakers on the left arch and 5 + 17 on the right; these counts are clearly in the range of variation for *Parathunnus atlanticus*. Other measurements and counts for this specimen (made after preservation for six months in formalin), following the method of Marr and Schaefer (1949, U. S. Fish and Wildlife Ser., Fishery Bull., 47: 241-44), are as follows: Total length, 42.5 cm.; head length, 12.0 cm.; snout to insertion of first dorsal, 13.4 cm.; snout to insertion of second dorsal, 24.0 cm.; snout to insertion of anal, 26.8 cm.; snout to insertion of ventral, 13.9 cm.; greatest depth, 11.3 cm.; length of pectoral, 11.7 cm.; pectoral insertion to insertion of first dorsal, 6.4 cm.; length of base of first dorsal, 9.8 cm.; length of base of second dorsal, 4.1 cm.; spread of caudal, 12.2 cm.; length of longest dorsal spine, 5.0 cm.; length of first dorsal spine, 5.0 cm.; length of second dorsal, 3.5 cm.; length of anal, 2.9 cm.; length of longest dorsal finlet, 1.4 cm.; diameter of iris, 1.2 cm.; length of maxillary, 5.0 cm.; least depth of caudal peduncle, 1.0 cm.; greatest width of caudal peduncle at keels, 2.6 cm.; number of first dorsal spines, 13; number of dorsal finlets, 9; number of anal finlets, 8. Sex, female; weight, 3.75 lbs.

The range of *Parathunnus atlanticus*, according to Beebe and Tee-Van (1936), is "Known from the coast of Florida, Bermuda, Haiti, Martinique, the following islands in the British West Indies: St. Lucia, Union, Grenada and Tobago, and from Trinidad Island, Brazil." Whiteleather and Brown (1945, Anglo-American Caribbean Comm., Washington, D. C.: 107) listed this tuna in "An Experimental Fishery Survey in Trinidad, Tobago, and British Guiana," and Rivas (1949, Fla. Bd. Conserv., Ed. Ser. 4: 10) recorded it in "Check List of the Florida Game and Commercial Marine Fishes." We can find no reference to its occurrence north of Bermuda, or north of Florida along the United States coast. The capture of the fish off North Carolina, therefore, constitutes an unusual record, if not a new northern record for the species.—HOWARD A. SCHUCK, *U. S. Fish and Wildlife Service*, and FRANK J. MATHER, III, *Woods Hole Oceanographic Institution, Woods Hole, Massachusetts.*

¹This cruise was undertaken jointly by the Institute of Fisheries Research of the University of North Carolina and the U. S. Fish and Wildlife Service. This report appears by permission of both organizations.

RECENT RECORDS OF THE GREAT WHITE SHARK, *CARCHARODON CARCHARIAS*, ON THE WASHINGTON COAST.—A specimen of *Carcharodon carcharias* (Linnaeus) was taken in a shark gill net, $\frac{1}{2}$ mile north of the Gray's Harbor north jetty, Gray's Harbor County, on August 16, 1949. This shark was caught by Tom Fuller, a fisherman, and brought to the Whiz Fish Company station, Westport, Washington, where it was examined and identified. It was a female, 10 feet 10 inches long, and weighed 700 pounds. The stomach was empty. The liver weighed 150 pounds, and was sent to Washington Laboratories, Seattle, to determine the vitamin A content. These Laboratories reported that the liver contained 69.6 percent oil of potency 2060 U.S.P. units per gram; this organ therefore contained 0.65 million U.S.P. units of vitamin A per pound. The vitamin A content of oil for this species from Florida waters ranged from 700–7000 U.S.P. units per gram (Butler, 1948, U. S. Fish and Wildlife Serv., Fish. Leaflet 233).

On September 1, 1950, Mr. Raymond Nelson obtained a great white shark $14\frac{1}{2}$ feet long that was estimated to weigh 2000 pounds; it was caught in his gill net in Willapa Harbor, Pacific County, near buoy 22. The functional row of teeth on the upper jaw had all been removed except for one near the center of the jaw. This tooth was equilateral, and measured $1\frac{3}{4}$ inches across the base, at the juncture of the dentine with the pulp. No cusp-like projections were present on any of the teeth. The liver from this specimen weighed 350 pounds. Examination of the stomach contents revealed 150 specimens of variously sized crabs, primarily *Cancer magister* and a lesser number of *Cancer productus*, four partly digested salmon, two hides of hair seals, and a quantity of vertebral columns of hake, *Merluccius productus*, and rockfish, *Sebastes*.

A search through the literature indicates that this is the first record of crabs being found in the stomach of *C. carcharias*.

The posterior edge of the pectoral fin near the axil had a light-colored area, the tip of the pectoral a grayish-white spot. This contrasts with the color markings of the pectoral fin reported by Bigelow and Schroeder (1948, Fishes of the Western North Atlantic, Sears Found. Marine Res., 1 (1): 37).

The jaws from this shark were removed and sent to the School of Fisheries, University of Washington, where they were cleaned and dried by Dr. A. D. Welander for further study and exhibition.

Prior to 1949, six specimens of *C. carcharias* had been recorded from the Washington coast (Bonham, 1942, Copeia (4) 264–66); five of these were obtained from Willapa Harbor.—E. H. LEMIER, Washington State Fisheries Laboratory, University of Washington, Seattle 5, Washington.

THE AUTHORSHIP OF NAMES PROPOSED IN CUVIER AND VALENCIENNES' "HISTOIRE NATURELLE DES POISSONS."—For many years after the appearance of Cuvier and Valenciennes' monumental work (1828–49) it was conventional practice to cite both men as authors of the new names proposed therein. The addition of Cuvier and Valenciennes (Cuv. and Val., or C. and V.) to the name of a genus or species came to be a convenient abbreviated reference since they collaborated in no other important paper. Certain recent writers have broken with long-standing practice and cite either Cuvier or Valenciennes, but not both, as authors of names proposed in the *Histoire Naturelle des Poissons*. A majority of workers, however, still credit dual authorship. Thus, current practice is confusing. Presumably some who adhere to dual authorship are cognizant of the reasons why others have changed. Reluctance to do likewise may be based on disagreement with the premises which, to others, dictate the

practice of citing a single author, or may simply express a reticence to break with tradition. Many workers are unfamiliar with the basis for the present lack of uniformity.

In addition to the species named as new in the "Histoire Naturelle" by Cuvier and by Valenciennes, there appear the original descriptions of some species ascribed by these authors to other workers. This discussion is not concerned with such names, but in view of the method of presentation and the obvious intent of the authors, these names should properly be credited to those who contributed to this epochal monograph (1950, Bull. Zool. Nomen., 4 (19/21): 564-66).

The title page of each of the 22 volumes which comprise the "Histoire Naturelle" bears the names of both Cuvier and Valenciennes despite the fact that Cuvier died in 1832 while Volume 9 was passing through the press, 17 years before the appearance of the last volume. However, scrutiny of the table of contents of early volumes discloses the actual authorship of any given page, section, or volume. In the preface to Volume 9 (p. xij) Valenciennes, in his eulogy to Cuvier, wrote:

Nos lecteurs trouveront toujours, dans les tables de chaque volume, la signature de M. Cuvier à la suite des articles qu'il aura laissés en état d'être imprimés sous sa responsabilité scientifique.

It was clearly the practice of Cuvier and Valenciennes to divide the task between themselves, each assuming responsibility for the report of certain sections. For example, in Volume 2 we find that Cuvier prepared pages 1 to 238, 249 to 262, and 387 to 490, whereas Valenciennes wrote pages 238 to 249, and 262 to 386. Gill (1874, Smithsonian Misc. Coll., 247 (1872): 41-43) knew of the segregation of portions of this work, but he was in error or in doubt about some parts. It may be surmised that Gill did not note the by-lines in the tables of contents but used some less reliable method to establish authorship.

Determination of the author of the new taxonomic names proposed depends on the interpretation of Article 21 of the International Code of Zoological Nomenclature:

The author of a scientific name is that person who first publishes the name in connection with an indication, a definition, or a description, unless it is clear from the contents of the publication that some other person is responsible for said name and its indication, definition, or description.

Recently the International Commission of Zoological Nomenclature has emended Article 21 (1950, Bull. Zool. Nomen., 4 (19/21): 565) to deal with this precise situation:

Where in a book or paper written jointly by two or more authors, it is clearly stated that one of those authors is exclusively responsible for the description of one or more specified taxonomic units there named, the name or names so published are to be attributed solely to the author stated to be responsible for the descriptions thereof and not jointly to both or all of the joint authors of the book or paper.

In view of the clear specification of responsibility in the "Histoire Naturelle" itself it is obviously proper to credit authorship accordingly—to Cuvier or to Valenciennes, but not to both.

In the table of contents for volumes 10 to 22 there appear no signatures, so it is apparent that Valenciennes assumed responsibility. The circumstance that Valenciennes frequently used the courtesy expression "nous" and followed the name of each new form or name combination with "nob." (*nobis* = of us) has no bearing on the question of authorship.

Valenciennes' position in respect to those volumes prepared and published after Cuvier's death has been stated by him (Volume 9, p. x):

Il m'a chargé de terminer l'ouvrage auquel il avait bien voulu m'associer; les nombreux matériaux que nous avions réunis ensemble sont maintenant à ma disposition. J'exécute religieusement les derniers ordres de mon illustre ami; et, si je puis hasarder cette expression, j'aurai la gloire d'avoir complété ses oeuvres, autant du moins que mes forces le permettront.

To credit Cuvier as coauthor of the last 13 volumes and of all included new names is to reduce to absurdity the responsibility and privilege of authorship. In Volume 11 (pp. 504-06) "*Opisthognathus Cuvierii*, Nob.," is described as a new species. Following the pattern of dual authorship it would be necessary to cite this form as *Opisthognathus cuvieri* Cuvier and Valenciennes, a ridiculous stratagem which certain authors have, in fact, adopted. It is clear for this and most other new forms in volumes 10 to 22 that Valenciennes was "responsible for said name and its indication, definition, or description." For a few new names, however, it is specifically indicated in the text that the name and description were drafted by Cuvier. Those genera and species should, I believe, be credited to Cuvier alone. For names which were coined by Cuvier, but for which it is not clearly stated that he drew the description I feel that under Article 21 Valenciennes is properly to be regarded as author.

Unfortunately, the *Histoire Naturelle des Poissons* is not readily accessible to all workers. Even to those who have it at hand the task of determining authorship is time consuming, and, if hurried, may lead to error. I have therefore checked the entire work and list below the pagination prepared by each author. Volume 1 (1828) includes a history of ichthyology, and a general treatment of the anatomy of fishes. No new names were proposed. Although authorship is not specifically indicated, Cuvier is evidently responsible. For the next 8 volumes responsibility for authorship may be determined (with minor exceptions as noted above) from the following table. I include the date given on the title page, and the month and year of publication as determined by Sherborn (1925, Ann. Mag. Nat. Hist., ser. 9, 15: 600).

Volume	Date (from title page)	Date of Publication (from Sherborn)	Page- number	Author
2	1828	Oct. 1828	1-238 238-249 249-262 262-386 387-490	Cuvier Valenciennes Cuvier Valenciennes Cuvier
3	1829	Apr. 1829	1-500	Cuvier
4	1829	Nov. 1829	All	Cuvier (see p. xxviii of Volume 5)
5	1830	July 1830	All	Cuvier
6	1830	Sept. 1830	1-425 426-491 493-559	Valenciennes Cuvier Valenciennes
7	1831	Apr. 1831	1-440 441-531	Cuvier Valenciennes
8	1831	Jan. 1832	1-470 471-509	Cuvier Valenciennes
9	1833	Mar. 1833	1-198 199-329 330-359 359-371 372-427 429-512	Cuvier Valenciennes Cuvier Valenciennes Cuvier Valenciennes
10	1835	Sept. 1835	All	Valenciennes
11	1836	July 1836	All	Valenciennes
12	1837	Mar. 1837	All	Valenciennes
13	1839	Apr. 1839	All	Valenciennes
14	1839	Jan. 1840	All	Valenciennes
15	1840	Nov. 1840	All	Valenciennes
16	1842	Aug. 1842	All	Valenciennes
17	1844	July 1844	All	Valenciennes
18	1846	Aug. (or Sept.) 1846	All	Valenciennes
19	1846	May 1847	All	Valenciennes
20	1847	Nov. 1847	All	Valenciennes
21	1848	Sept. 1848	All	Valenciennes
22	1849	Jan. 1850 (i.e., end of 1849)	All	Valenciennes

Since it is now becoming usual to give authors' names in full, rather than by abbreviation, some workers will take satisfaction in shortening "Cuvier and Valenciennes." However gratifying this may prove, the argument is in itself without legality.—REEVE M. BAILEY, Museum of Zoology, University of Michigan, Ann Arbor, Michigan.

THE PADDLEFISH IN FORT PECK RESERVOIR, MONTANA.—In July of 1948, Mr. Donald E. Johnson caught a paddlefish, *Polyodon spathula* (Walbaum), 37¾ inches long, below the spillway of Fort Peck Dam which lies athwart the Missouri River in northeastern Montana. The snout or paddle of this fish was bent so that the distal third doubled back over and against the uninjured portion (Fig. 1). The injury, which was entirely healed, caused separation of the two parts approximately one-half the width of the snout; however, circulation was adequate to keep the bent portion alive. The cause of injury can only be presumed, but the location of this fish below the spillway suggests that it might have had a fast trip over the dam to the concrete spillway below.

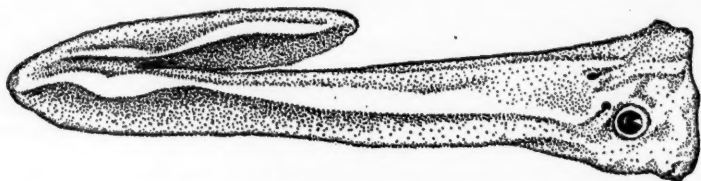


Fig. 1. Head of paddlefish (left side) showing bent snout. Drawing by Vernon Craig.

There is no authentic record of paddlefish for Montana before 1946. Jordan (1878, Bull. U. S. Geol. and Geog. Surv. (Hayden Surv.), 4: 777-78) reported a "gristle-nosed" fish from Saint Mary's River collected by Elliott Coues on August 16, 1874, and indicated it to be "perhaps *Polyodon folium* Lac." This is very unlikely, since the Saint Mary's River is tributary to the Belly and Saskatchewan Rivers and is therefore outside the known range of this species.

In mid-February, 1946, four small boys from Glasgow, Montana—Bob McInerney, Jimmy Nelson, Bill Stuart and John Gilbert—caught three paddlefish which were stranded in the Milk River just east of the civic center in Glasgow. The largest of these was 56¾ inches long and weighed 31 pounds. The other two weighed 30 and 27 pounds, respectively. The smallest specimen, which measured 52½ inches (total length), was mounted and presented to Montana State College by the Glasgow Chamber of Commerce. It is in the fish collection of the College at the present time, along with two other smaller specimens collected since.

This species is now rather abundant in the upper end of Fort Peck Reservoir as well as in the "cuts" below the dam, and several are caught each year. Since all forms of commercial fishing are prohibited in this vast wilderness lake of approximately 245,000 surface acres, the population of *Polyodon* is left largely undisturbed.—C. J. D. BROWN, Department of Zoology and Entomology, Montana State College, Bozeman, Montana.

A QUICK DRYING INK FOR LABELING CELLULOSE ACETATE SLIDES.¹—

A water-proof, quick drying ink has been developed for writing on slides of cellulose acetate used in making fish scale impressions. The ink dries in a few seconds, becoming an integral part of the sheet. It can be applied with a steel ball point pen, and has not faded in trials over the period of a year. This ink is simple and quick to make. Dissolve 1 gram of cellulose acetate in 22 cc. of acetone, add 0.13 grams of Gentian Violet and 13 cc. of glacial acetic acid. Although the ink tends to dry on the pen, no difficulty should be encountered if lettering is done rapidly. Small quantities of acetone should be added to the stock from time to time to replace that lost by evaporation.—DEXTER S. HAVEN, Virginia Fisheries Laboratory, Gloucester Point, Virginia.

¹ Contributions from the Virginia Fisheries Laboratory No. 33.

REVIEWS AND COMMENTS

IOWA FISH AND FISHING. By James R. Harlan and Everett B. Speaker. State of Iowa Printing Board, Des Moines, 1951: vi + 237, figs. 1-9, plates 1-22 (9 in 4-color), \$2.00.—This attractive book, which appears from a state not well known for its considerable fishing attractions, covers in detail nearly all fishing subjects within Iowa's boundaries. A few regrettable type-setting errors occur in titles of certain line drawings, but on the whole the workmanship is clean.

Authors Harlan and Speaker wisely refrain from mixing ichthyological facts with angling fancies in writing for the widest possible number of laymen. Some chapters are prepared particularly for anglers, and others are especially for fish or fish management specialists. Readers from each group will find no insult to intelligence or curiosity, and each group will stray in reading to pages written for the other.

Portions of greatest interest to ichthyologists are 50 pages of checklist and keys to Iowa fishes, a glossary, and a list of 38 titles dealing with Iowa fish distribution and taxonomy. This section, prepared by Dr. Reeve M. Bailey, is printed only after first being mimeographed and tested for several years. The keys to the 137 species and subspecies of Iowa fishes are illustrated with line drawings. Most recent rules of nomenclature are followed.

Anglers or laymen will find introductory pages describing Iowa's fishing waters, including 44 trout streams offering 150 miles of specialized angling, 55 natural lakes, and 38 artificial lakes or reservoirs. The body of the book is filled with information on food habits, general life histories, and angling importance. A chapter on fish foods and several chapters on angling techniques are prepared by specialists and include original research data.

One outstanding feature is the inclusion of nine 4-color plates containing excellent reproductions of 24 species. It is refreshing to find a new set of color illustrations painted by a competent Iowan and printed in the United States by displaced German craftsmen of great skill. Fittingly, the color plate of the black bullhead and channel catfish, Iowa's angling favorites, is a nearly perfect reproduction of fish in prime condition. The color plates alone for this volume cost \$11,000. Additional black-and-white reproductions are given of 65 other species, from photographs made of Iowa specimens.

Advance sale and early demand has nearly consumed the original printing's 10,000 copies. A second printing is scheduled in which the few type-setting errors of the first will be corrected.—RAYMOND E. JOHNSON, *Dept. of Conservation, Div. of Game and Fish, St. Paul 1, Minnesota.*

FISHING IN THE WEST. By Arthur H. Carhart. The Macmillan Co., New York, 1950, 144 pp., illus. \$4.00.—In this well written and informative book, the author shares with his reader the experiences he has gathered through 30 years of roaming over the western third of the United States, from both slopes of the Rockies to the Pacific Coast. Mr. Carhart is a rare combination of an accomplished angler and outdoorsman who is sensitive to, and appreciative of, nature, and whose inquisitive mind has led to his delving into the origin and classification of trout and to an understanding of the basic issues of conservation.

All the major types of waters in the diverse topography of the West are treated. In addition to the trouts and their relatives, warm-water species, sturgeon, ling (*Lota*) and even the Colorado squawfish (*Pychocheilus lucius*) are discussed. The chapter on the cutthroat trouts is a particularly good one, in which the author summarizes our knowledge of the origin and distribution of a species whose natural range has been drastically curtailed by man's activities. The suggestion that the Colorado River cutthroat may have gained entry to the Colorado during the Ice Age by rounding Baja California is an interesting if debatable hypothesis. The theory of the origin, by isolating geological processes, of the many subspecies and races of *S. clarki* is ably presented.

The 14 chapters include 4 that deal largely with the kinds of fishes encountered, 4

on the various types of waters fished, 1 on the western fishing cycle, 1 on rods, 2 on flies and fly patterns, an interesting chapter on trout cookery and how to keep trout fresh, and a vital and well considered chapter on conservation entitled "Dust In Your Creels."

The book is remarkably free of errors. I have only recently shown that the San Geronio trout (p. 27) is a cutthroat, rather than a rainbow, type. By an obvious slip (p. 27) Pyramid Lake is stated to be in Oregon rather than Nevada. In pointing out (pp. 29-30) how the stocking of rainbow trout in streams originally inhabited by the cutthroat has caused the decline or elimination of the native fish through hybridization and competition, I note that the sixth photograph following page 84 shows hybrids between the rainbow and the Colorado cutthroat. The many photographs on enamel paper are excellent.

I have read few books on fishing in the West but this is one that I highly recommend to that growing horde of anglers, youngster and veteran alike, and to those interested in the history of our fishing waters and their much needed conservation. "A fisherman who has established understanding of the outdoors, who sees clearly what is impending in regard to our natural resources, must become a persistent conservationist."—ROBERT RUSH MILLER, *Museum of Zoology, University of Michigan, Ann Arbor, Michigan.*

CONSERVATION OF NATURAL RESOURCES. Edited by Guy-Harold Smith. John Wiley and Sons, New York, and Chapman and Hall, Limited, London, 1950: xii + 552. Illustrated. \$6.00.—America has been generously endowed with natural resources. Spread out before the pioneers were seemingly endless miles of wilderness, rich in all the requirements of human existence—tillable lands, great forests, bountiful mineral deposits, and abundant game. Today there is no longer a wilderness frontier. The westward population march from the Atlantic coast has reached the shores of the Pacific. Population increase and unwise use of our land and its resources has brought before us the hard fact that nature's offerings, although generous, are not endless. With one third of our top soil and seven-eighths of our lumber gone and vast inroads made into our irreplaceable mineral reserves, it is time, indeed past time, for every individual to think seriously and act intelligently to conserve what remains of our national heritage. As Mr. J. Russell Smith, one of the contributors to *Conservation of Natural Resources* states, "Someone has said from the Stone Age we came, and to the Stone Age we must return." But why should we hurry so to get there?"

The foregoing paragraph sets the theme of the essays that compose this book. Twenty men, including the editor, specialists in various phases of natural resource conservation, have contributed chapters. The book begins with a discussion of development of conservation in the United States, followed by chapters on each resource. The following topics are treated: The great soil groups, their utilization, and soil conservation; tree crops (proposed as useful in augmenting agricultural output, particularly on marginal and submarginal lands); irrigation; grassland resources; reclamation of wet and overflow lands; the agricultural prospect; our forests and their conservation; water supplies, their use and conservation, with chapters on water power, waterways and flood control; conservation of minerals, with a chapter on mineral fuels (coal, oil, gasoline, and natural gas); fisheries and conservation of wildlife; and recreational resources and the conservation of man. The book concludes with sections on local, state, and national planning, necessary for effective implementation of conservation programs.

Each resource is defined, its extent and distribution is outlined, its use in regional and national development is discussed, and conservation measures are considered.

This book is an important and timely contribution. Its editor and authors are to be commended for its high quality. There is little to criticize. However, I find it somewhat lacking in synthesis, probably an inevitable consequence of its combined authorship. It is a collection of separate analyses of natural resources and their conservation. The interlocking nature of many of the resources might have been given more emphasis. Soils, water, forests, and grasslands are inextricably associated.

I was disappointed in not finding a discussion of the problem of population increase (on a national and world basis), which is one of the important causes of the depletion of our natural reserves. The book devotes itself to correction of wasteful practices, development of conservation awareness, better methods of using and obtaining increased output from our resources, and, in some instances, suggests substitutes that may help to

compensate for an exhausted resource. These are important approaches to the problem and perhaps the only practical ones. But it is inescapable that the life of our irreplaceable resources and the adequacy of our replaceable ones would be increased if upward population trends were to level off. Perhaps this fact can be inferred by the reader, but a matter of such significance to our national welfare might have been given special attention. Although it is not clear how the problem of the increasing mass of humanity can be solved, particularly since birth control is so closely associated with human ethics, we can, at least, strive for widespread awareness.

Education is of utmost importance in developing conservation awareness but we need to do better than in the past. As Ellsworth Huntington, one of the contributors writes, "Incredible as it may seem, we, who claim to be the most advanced of nations, spend approximately three times as much on tobacco and alcoholic beverages as on educating our crop of children and keeping them in good health from infancy to maturity."

The book is readable, well written, and adequately illustrated. There are few typographical errors. I highly recommend it.—ROBERT C. STEBBINS, *Museum of Vertebrate Zoology, University of California, Berkeley 4, California.*

EDITORIAL NOTES AND NEWS

University of Wisconsin

DR. JOHN C. NESS has finished a post doctoral year as an A.E.C. fellow at Brookhaven National Laboratory and has returned to join the staff of the Department of Zoology, University of Wisconsin. He will direct the plankton research and collaborate in fishery research as statistician. He will teach a course in ecology, and develop one in fishes and amphibians. Grants-in-aid for research in the limnology-fishery program have been received from the Wisconsin Alumni Research Foundation, U. S. Office of Naval Research, U. S. Fish and Wildlife Service, Mr. Ben S. McGiveran, International Minerals and Chemical Corp., Wisconsin Conservation Department, Mr. J. B. Allen, and Brookhill Farms, Inc. Graduate Students receiving stipends from these grants are: RICHARD C. DUGDALE, OSCAR M. BRYNILDSON, KENNETH R. JOHN, ROBERT LOEFFLER, J. RALPH NURSALL, WALDO E. JOHNSON, WILLIAM T. HELM, WARREN J. WISBY, ROBERT A. RAGOTZKIE and CARL A. SCHEEL.

Atlantic Fisheries

THE International Commission for the Northwest Atlantic Fisheries, which convened at Washington, D. C. on April 2, 1951, elected HILARY J. DEASON, Chief of the Office of Foreign Activities of the U. S. Fish and Wildlife Service, Chairman, and A. T. A. DOBSON, Fisheries Adviser of the Ministry of Agriculture and Fisheries of the United Kingdom, as Vice-Chairman, for two-year terms. WILLIAM ROBERT MARTIN, Senior Biologist of the St. Andrews Biological Station, New Brunswick, was elected Acting Executive Secretary for the period July 1, 1951 to June 30, 1952. The work of the Commission is to provide for international cooperation in the coordination, correlation, and dissemination of information concerning the fisheries of the northwest Atlantic Ocean. Participating governments are, in addition to the United States and United Kingdom, Canada, Denmark, and Iceland. France, Italy, Norway, Portugal and Spain have yet to ratify the Convention. For the time being, the headquarters of the Commission are at the St. Andrews Biological Station of the Fisheries Research Board of Canada, where the second meeting is scheduled to be held about June 10, 1952.

News
Notes

BILLY DANIEL, 12 years old and the youngest member of the Society, attended the recent meetings in Chicago, commuting from his home at 4220 Wilson Road, Kenosha, Wisconsin.

MILTON B. TRAUTMAN was awarded an honorary degree of Doctor of Science by Wooster College, Ohio, on June 11, 1951.

FRANK B. CROSS, who received his Ph.D. from Oklahoma A. and M., is now instructor in the Zoology Department and curator of fishes in the Natural History Museum at the University of Kansas.

CHARLES B. WADE arrived in Lima, Peru, on June 2, 1951, for a stay of a year or longer, in connection with the Office of Foreign Activities, U. S. Fish and Wildlife Service. He will advise the Peruvian government on the design, construction, staffing, and operation of a marine research laboratory and an exploratory vessel.

The Scripps Institution of Oceanography (University of California) has recently become formally associated with the Inter-American Tropical Tuna Commission, which was set up under a treaty between the United States and Costa Rica. This group, with laboratory space on the La Jolla campus, is studying life history and ecology of the tuna and of important bait species. The Commission plans to make oceanographic surveys similar to those being carried out by the California Cooperative Sardine Research Program. A second laboratory is established at Puntarenas, Costa Rica, where preliminary studies of the anchovetta are in progress.

DR. ENRICO TORTONESE of the Instituto e Museo de Zoologica della Universita di Torino, Italy, writes that he is now working on Mediterranean sharks, "badly in need of revision," and that the Zoological station of Naples has asked him to prepare the sections on Iniomi and Plectognathi of the new issue of the great monograph on the eggs and juvenile stages of Mediterranean fishes (Monograph 38 of the Faune e Flora del Golfo di Napoli). He is also much interested in problems of fish evolution and speciation.

WILLIAM E. FAHY recently finished his doctorate at the University of Rochester where he was working with the late PROFESSOR SHERMAN C. BISHOP. His dissertation is entitled "The life history of the northern greenside darter, *Etheostoma blennioides blennioides* Rafinesque." DR. FAHY has taken a position effective July 15 as aquatic biologist at the Institute of Marine Research, University of North Carolina at Morehead City, North Carolina.

DR. WILLIAM F. ROYCE is transferring from North Atlantic Fisheries Investigations, Woods Hole, Massachusetts to Pacific Oceanic Fisheries Investigations, as Chief Biologist, stationed at Honolulu, T.H., c/f U. S. Fish and Wildlife Service, P.O. Box 3830.

Word has been received of the death of DR. GEORGE MILTON SMITH of Pine Orchard, Connecticut. DR. SMITH, a physician interested in ichthyology, died on February 26, 1951. He has been a member of the Society since 1935.

Word has also been received of the deaths of two other members of the Society: DR. H. E. EWING of Tacoma Park, Maryland and DR. SOUTHGATE Y. HOYT, Ithaca, New York.

The Central Fisheries Research Station at Winnipeg, Manitoba, Canada, has moved into more commodious quarters with better facilities at 165 Garry Street in Winnipeg, Manitoba. DR. KENNETH H. DOAN is Acting Director.

PROFESSOR LEON BERTIN has announced that five fascicules of the *Catalogue des Types de Poissons* in the Paris Museum are available and that a sixth fascicule is in preparation. The first fascicule of the *Catalogue des Types d'Amphibiens* is in preparation. It is planned to publish 24 fascicules for fishes and 6 for amphibians and reptiles. The price for the 5 parts published to date is 300 francs each (or about \$0.30 apiece). There are 48 pages in Part 1 (Cyclostomes et Sélaciens) and 79 pages in Part 2 (Dipneustes, Chondrosteens, Holosteens et Isospondyles), and each of these parts has its own index. The editors have not seen any of the other parts. Orders should be addressed to: L'Imprimerie Nationale, 27, rue de la Convention, Paris (XV°).

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